BRC

INSTRUCTION BOOK NO. PH590-A

INSTALLATION, OPERATION AND SERVICE

BRISTOL'S MODEL 590 WIDE-STRIP DYNAMASTER

D-C POTENTIOMETER AND D-C BRIDGE

WITH ZENER DIODE REFERENCE VOLTAGE SOURCE

SERIAL NO._____ CUST. ORDER NO._____

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RECORDING
INDICATING
CONTROLLING
TELEMETERING

INSTRUMENTS

BRISTOL'S

THE BRISTOL COMPANY
WATERBURY 20, CONN.

PLACE THESE INSTRUCTIONS WITH THE MAN IN CHARGE OF YOUR INSTRUMENTS

I M P O R T A N T

1. Read these instructions NOW before installing instrument.

2. Keep these instructions permanently & accessibly filed for future reference.

3. Be sure to specify MODEL & SERIAL numbers when ordering parts, instructions, diagrams or data.

4. Ship instruments or parts for repair or exchange only to Bristol's main or branch factories—not to Sales Offices.

5. Be sure to—
   1. Identify your shipments with your exact return address & order number.
   2. Write nearest Bristol Factory or office giving your order number, directions & address for return shipment, full instructions for repair, etc.

6. Report damage to shipments at once to shipping company. The *customer assumes responsibility for collecting any claim for damages* from the shipping company, on all shipments made on a collect basis.

WHO WILL SERVICE YOUR BRISTOL INSTRUMENT?

Divided responsibility produces misunderstanding and inattention. We therefore urge that all Bristol instruments in your plant be assigned to the care of one responsible man. He will rapidly become so familiar with routine chart changing, inking, checking and adjusting necessary to keep instruments in good working order, as to require only a few minutes time per day. Bristol will be pleased to supply additional information or personal instruction to instrument service men.

INSTRUCTION BOOK NO. PH590-A

ISSUE NO. 1

INSTALLATION, OPERATION AND SERVICE

BRISTOL'S MODEL 590 WIDE-STRIP DYNAMASTER

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FOR SERIAL NO._____ CUST. ORDER NO._____

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Instructions Y19820
Issue of Sept. 1961

INSTRUCTION NO. Y19820

INSTALLATION AND SERVICE OF BRISTOL'S® MODEL 560, 570 & 571 CASE AND WIDE-STRIP RECORDING SYSTEM

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THE BRISTOL COMPANY WATERBURY 20, CONN.

Note: This instruction covers the installation and service of the case and wide-strip recording system only. See separate instructions furnished covering the basic balancing, amplifying and switching systems in the Bristol Dynamaster Potentiometer, D-C Bridge or A-C Bridge-type Instruments. See also separate instructions covering measuring elements, controls, alarms, etc., as required.

PART I INSTALLATION

A. Unpacking the Instrument

Do not throw away the packing material until you have found the mounting brackets and screws as shown in the mounting-dimension drawing, and the other accessories, such as ink, charts, spare parts, etc.

B. Locating and Mounting the Instrument

The Dynamaster may be surface mounted or flush panel mounted. Although the instrument is exceptionally free from the effects of dust, dirt, vibration, corrosive fumes and extremes of temperature, it should be located as remotely as possible from such unfavorable conditions. The location should also be convenient for service and general utility.

The instrument should be reasonably level. Proper clearance should be allowed between the Dynamaster and other instruments on the wall or panel, and clearance must be given at the bottom of the case for the wiring or piping connections.

C. External Wiring and Piping

Before connecting any wiring to the Dynamaster, check the voltage and frequency listed on the nameplate of the instrument. To connect the Dynamaster to any voltage other than 120 volts, a suitable transformer must be used. All wiring connections are made on the terminal strips mounted inside on the back of the case. The terminals are readily accessible by opening the door of the Dynamaster and swinging the panel out after first depressing its latch.

The instrument is provided with four holes in the bottom of the case to accommodate standard conduit fittings. Two of the holes accomodate 1 1/4" conduit connections and the other two accommodate 3/4" conduit connections. Conduit should be used whenever possible to bring all electrical circuits into the case. If conduit is not used, the rubber grommets supplied with the instrument should be used by punching a small hole in the center of the grommet.

The wiring diagrams for your particular Dynamaster are provided separately. The measuring circuit is usually covered on one sheet and the power circuit on another sheet. If your instrument is equipped with an electric control or alarm, a third diagram will be furnished covering its wiring.

When connecting the power line to the instrument, make sure that the grounded side of the line is connected to the right-hand power terminal.

A good ground must be connected to the terminal marked GND.

Note: Do not install measuring circuits such as thermocouple wires in the same conduit with higher-voltage lines.

Piping or tubing will be required if a pneumatic control is supplied in the instrument. Air-control instruments are provided with case connections in the bottom of the case for standard 1/4" pipe or 3/8" copper tubing.

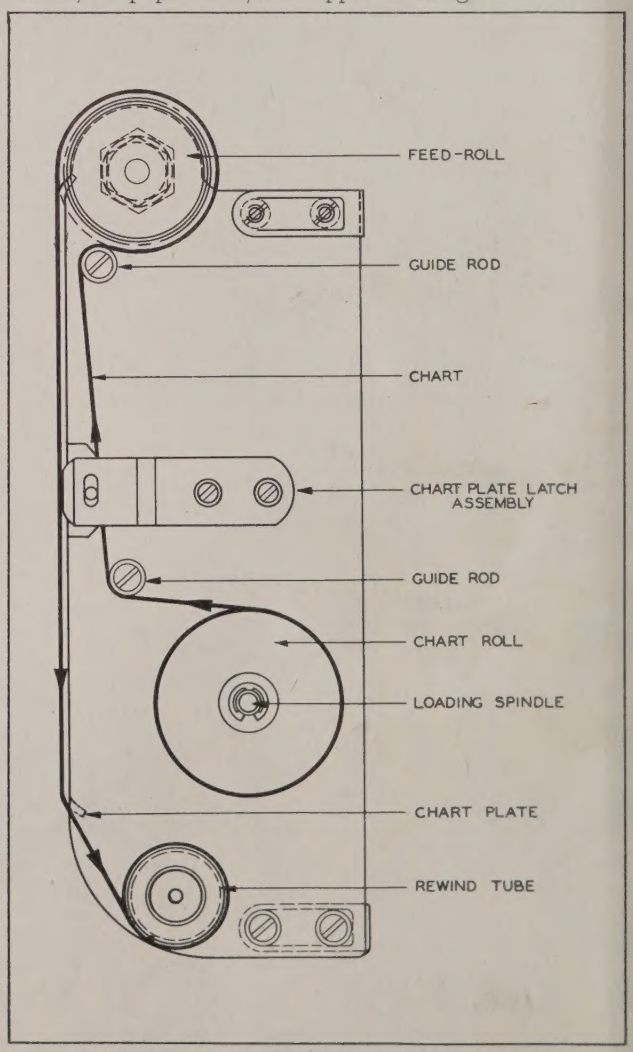


FIGURE I. CHART INSTALLATION DRAWING

D. Installing the Chart

A new chart roll must be flush with the left end of its tube. Before installing the chart, tap the left end (end with the round holes) on a flat surface to make sure that the tube and chart are flush. Release the chart-plate latch and swing out the chart plate. Fit the new chart roll onto the loading spindles (Fig. 1) with the round feed holes on the left. Thread the chart over the guide rods and under and around the feed roll (see Fig. 5). Latch the chart plate and attach the free end of the chart to the rewind tube with the clip provided. Take about 1 1/2 turns around the rewind tube and fit the tube onto the rewind spindles so that the key on the right rewind spindle fits into the slot in the tube. Tighten the chart by turning the rewind-spindle knob counterclockwise.

E. Installing and Starting Fountain Pens

Fountain pens are packed with the other accessories included with the instrument. Before installing the fountain pen or pens, the pen reservoirs must be filled with ink and the ink sucked thru the pen point by means of the pen starter provided. Then insert the pen or pens in the pen bracket, making sure that the pins on the pen go completely into the slots in the pen bracket. See Fig. 2 for installation of pens in 2-pen instruments.

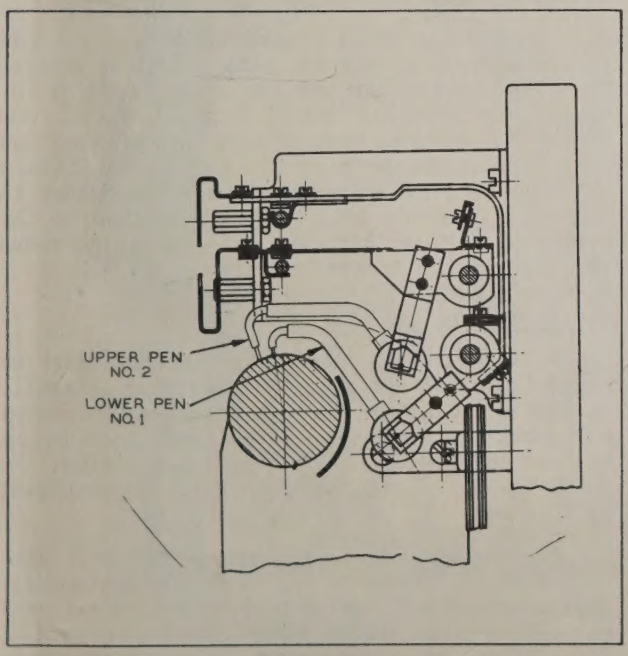


FIG. 2. INSTALLATION OF PEN ON TWO-PEN RECORDERS.

Multiple-point recorders are shipped with the print wheel and inked felts already installed.

F. Installing Ball-point Pens

Ball-point pens use a special mounting bracket as shown in figure 3.

To replace a ball-point pen, remove the cartridge end from the hole in the bracket and unscrew the pen end. Screw in the new pen and place cartridge end in bracket hole as shown in figure 3.

A ball-point pen should exert a force of approximately 15 grams on the chart paper for optimum recording results with a wide range of writing velocities. The mounting bracket design for this attachment assures the correct angle and pressure for this pen. The pen mounts perpendicular to the chart paper. The ink supply must always be above the ball-point, and the bending radius of the cartridge should not be less than 1/2 inch.

Ball-point pens are available in the following ink colors: Red, Part #A8253; Blue, A8254; Green, A8255; and Black, A8256.

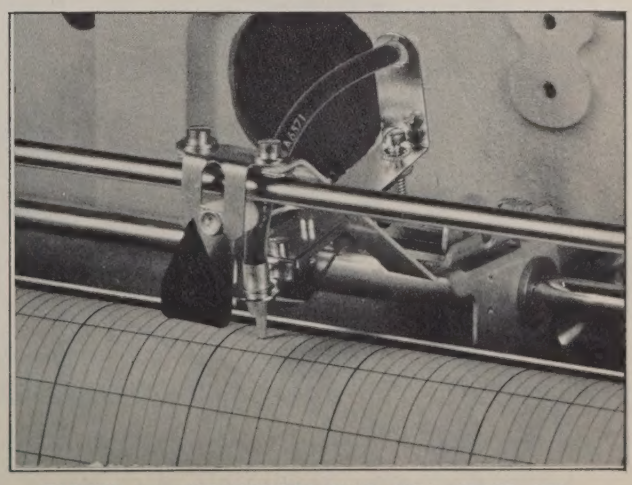


FIGURE 3. ATTACHMENT T113 BALL-POINT PEN

PART II SERVICE

A. Lubrication

1. Balancing Motor. Present motors, equipped with open gear train, have ball bearings which require no lubrication. However, the fibre gear that meshes with the motor pinion should be oiled with 2 or 3 drops of Gulf electric motor oil about once every six months. This light oiling of the fibre gear helps to prolong its life.

2. Multiple-point Recorders. The multiple-point Dynamaster requires lubrication of the print-wheel assembly and switching mechanism. There are three oil holes in the print-wheel assembly (Fig. 4). Oil these points once a year with Gulf electric motor oil.

There are three oil holes in the gear train of the switching mechanism. They should be oiled once a year.

The selector-switch contacts are normally self-cleaning. If it should be necessary to clean these contacts, they should be cleaned with a cloth and a solvent such as Inhibisol. After cleaning, the contacts should be lubricated with a very thin film of Cramolin. It is not necessary to remove the brush arm when cleaning the contacts. The brush arms may be rotated **counterclockwise** without damaging the unit or getting the print wheel out of step. If the brush arm is ever removed, note carefully the contacts on which the brush arm rests so that it may be returned to the same position. In addition to locating the brush arm correctly, the brush arm assembly should be pressed firmly against the hub of the switch-contact plate before tightening its setscrew. This guarantees the correct pressure on the contacts. Starting on or about June 1, 1954, the switch-contact-plate hub will have a locating pin that fits into a hole in the brush-arm assembly. In this way, if the brush arm is taken off, the brush arm can be easily and correctly returned to its synchronized position. Always push brush arm tightly against hub of contact plate before re-tightening its setscrew.

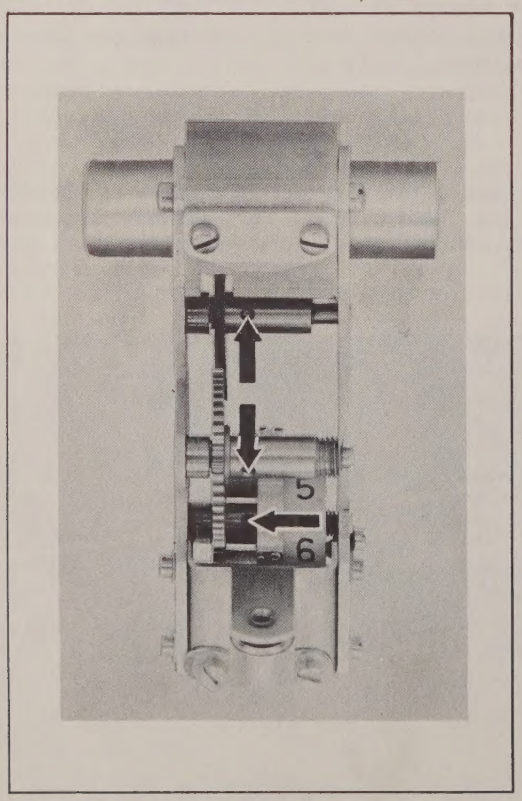


FIGURE 4. PHOTO SHOWING OIL HOLES ON PRINT WHEEL ASSEMBLY.

Holtzer-Cabot gear case motors with oil cup, used on the multiple-switching mechanism and when required on chart drives, should be oiled every **3 months** with **3 cc's** of Houghton Gearlub 890 (Bristol Part No. 91982 for 2 ounce can).

Nothing else should be oiled in the Dynamaster. All other bearings are either dry (and should be kept clean) or are permanently sealed and require no lubrication during their normal lifetime.

B. Care of the Pen in the Single-pen and Two-pen Recorders

The pen should be kept at least a quarter full of ink. If it clogs or draws a poor record, clean it with the wire pen cleaner provided. If necessary, wash the pen with soap and warm water.

C. Care of the Print Wheel in Multiple-point Recorders

When the printed record becomes too light for easy reading, the ink pads should be changed. The single-color ink pad may be replaced by removing the thumb nut and sliding off the old pad. The multi-colored pads should be replaced one at a time so that the color sequence will not get mixed up. When replacing the pad holder in the multi-colored unit, be sure to line up the pin in the holder with the hole in the gear and the hole in the indicating disk.

D. Lining up the Chart.

It is extremely important that the chart be correctly lined up. This is done very carefully at The Bristol Factory and should seldom need adjustment. However, if the left-hand guide pins on the feed roll should tear or distort the holes in the chart, the chart must be realigned as follows:

If the chart tends to tear on the left side of the holes, loosen setscrew in loading-spindle adjusting nut and turn adjusting nut in a clockwise direction until chart feeds properly. While making this adjustment, hold onto the collar located to the left of and on the same shaft

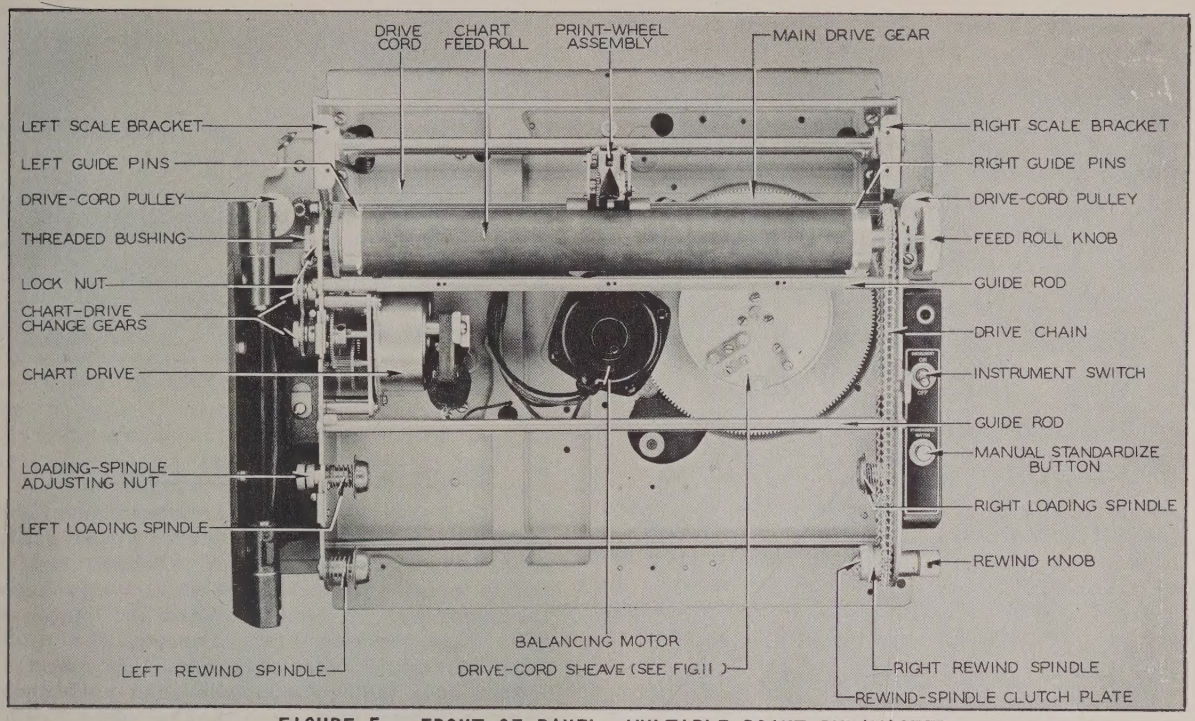


FIGURE 5. FRONT OF PANEL, MULTIPLE-POINT DYNAMASTER

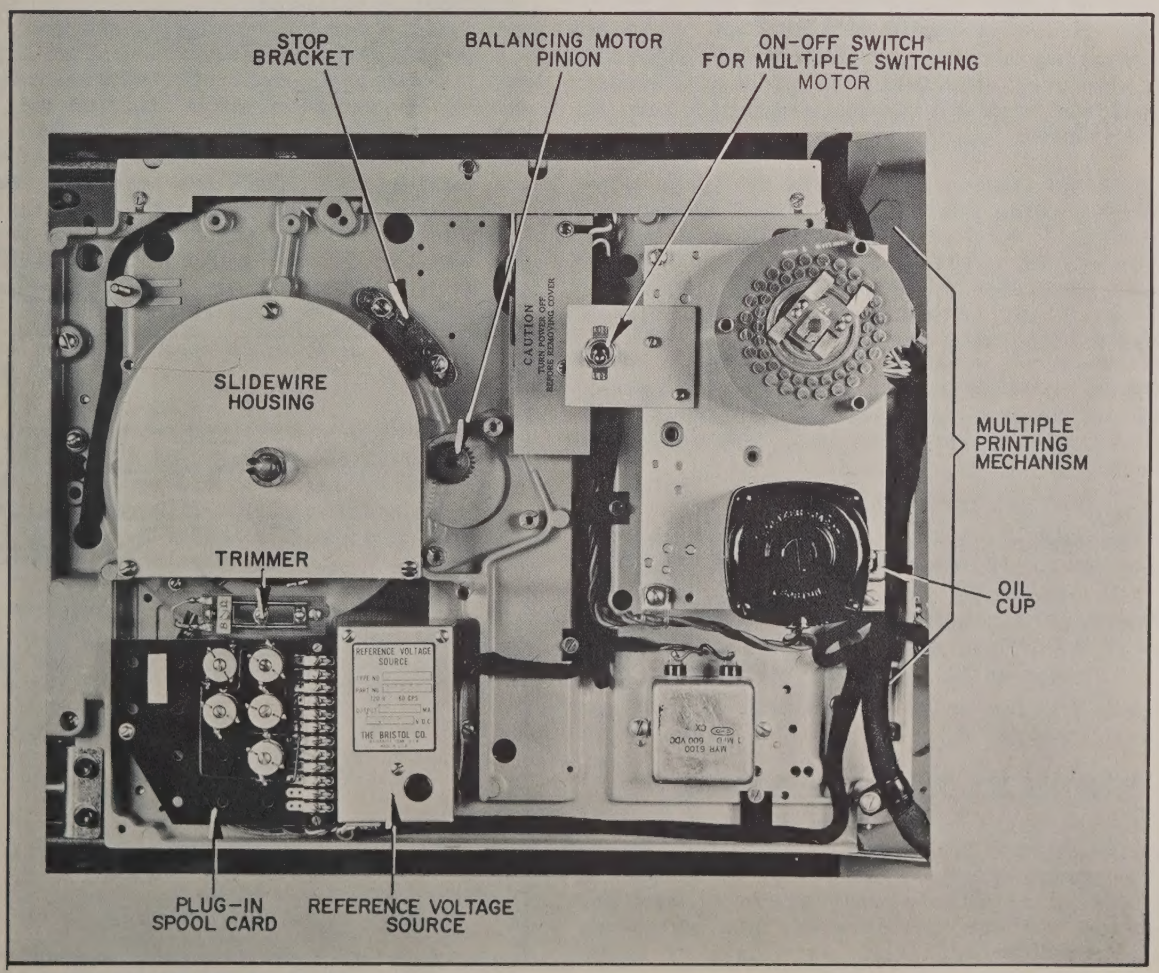


FIGURE 6. BACK OF PANEL, MULTIPLE-POINT DYNAMASTER POTENTIOMETER

as the adjusting nut. This prevents the shaft from turning while the adjusting nut is being turned.

If the chart tends to tear on the right side of the holes, turn adjusting nut in a counterclockwise direction until chart feeds properly.

If the chart tends to tear on the back side of the holes, the rewind-spindle clutch is too tight. To loosen clutch, turn rewind-spindle clutch plate counterclockwise (see Fig. 5). There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it. (See Par. F.)

E. Setting the Mechanical Zero

All Bristol Dynamaster Wide-Strip Recorders shipped after December 15, 1953 will be adjusted to have a live zero. The mechanical stop on these instruments will be set so that the pen is mechanically stopped at a point .035" below the live zero. This mechanical stop is referred to as the stop bracket in Figures 5 and 6.

As rapidly as possible, all wide-strip charts will be reprinted with a dotted line .035" below the live zero to indicate the position of the mechanical stop.

On older instruments not already adjusted to a live zero, the following procedure should be followed in resetting the mechanical zero to the new charts.

Turn off instrument. Rotate the large drive gear until stop pin hits the low side of stop bracket. If pen is not on the dotted line, loosen screws holding stop bracket and shift bracket sufficiently to permit pen to be moved to rest on the dotted line. Then retighten screws holding stop bracket.

When it is necessary to install a new pen or drive cord, or whenever the setting of the pen carriage has been disturbed, the following procedure should be followed:

1. Turn off instrument.
2. Rotate the large drive gear until stop pin hits the low side of stop bracket.
3. Set pen on dotted line below the live zero, by loosening drive-cord clamp on top of pen carriage and slide pen carriage until pen is on the dotted line.
4. Tighten drive-cord clamp and turn on instrument.

F. Adjusting the Rewind-spindle Clutch

If the chart rewind tube slips or rewinds loosely when the Dynamaster is operating, tighten the rewind-spindle clutch (Fig. 5) by turning the rewind-spindle clutch plate clockwise. There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it.

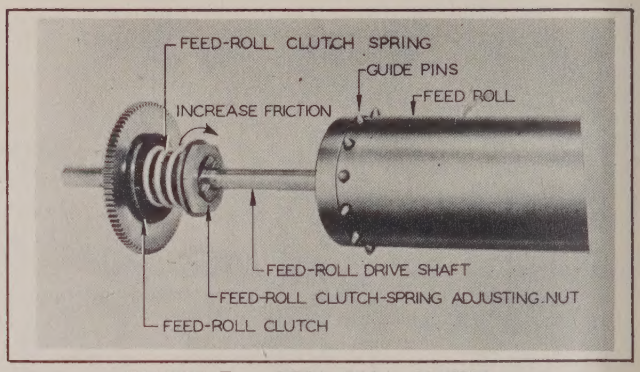


FIGURE 7. FEED ROLL CLUTCH

G. Adjusting the Feed-roll Clutch

The feed-roll clutch has been carefully installed at the Bristol factory and generally never requires adjustment. Under usual operating conditions, however, it may lose its friction. If it does not feed the chart smoothly at the correct rate, inspect the feed-roll clutch (Fig. 7) for slippage. By removing the rewind roll and turning the feed-roll knob, the clutch tension can be felt. The feed roll should **not** turn freely. If it does, the clutch is probably slipping.

To tighten the clutch, the entire feed roll must be removed. Take off the feed-roll knob and unscrew the setscrew in the feed-roll sprocket so that the sprocket turns freely. Remove both threaded bushings with their lock nuts, being careful not to lose the bearings. Move the left end of the feed roll out beyond the chart-assembly bracket and withdraw it from the drive sprocket. Push the feed-roll drive shaft through the feed roll until the clutch-spring adjusting nut is accessible. Tighten the ad-

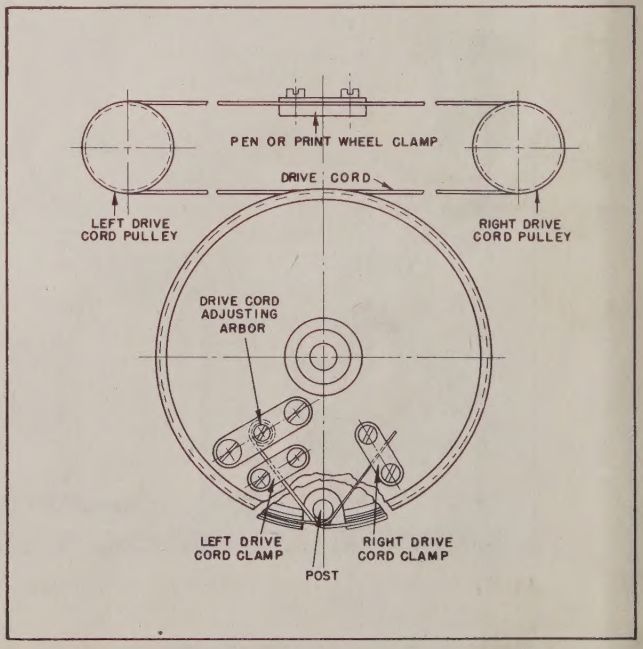


FIGURE 8. DRIVE CORD INSTALLATION DRAWING

justing nut until the clutch tension is sufficient to feed the chart correctly.

H. Replacing or Adjusting the Pen or Printwheel Drive Cord

To replace a broken or worn cord, loosen the drive-cord clamp on the drive-cord sheave, loosen the drive-cord clamp on the print-wheel or pen assembly and take out the old cord (Fig. 8). Turn the drive-cord sheave so that the clamps are at the bottom. Thread one end of the new cord under the left drive-cord clamp and thru the adjusting arbor. Tighten clamp. Thread the cord around the post and the right-hand side of the sheave (in the rear groove), around the left drive-cord pulley, thru the hole in the left-hand scale bracket, thru the hole in the right-hand scale bracket, around the right drive-cord pulley, around the left-hand side of the sheave (in the front groove), around the post, thru the right drive-cord clamp on the sheave. Tighten the clamp. Make sure that the cord is on all the pulleys, then turn the adjusting screw clockwise to tighten the cord to the proper tension. It should be tight enough to prevent backlash but not so tight as to cause the drive-cord pulleys to bind. Tighten the left drive-cord clamp and clip off any excess cord which may remain beyond the arbor.

Now clamp the print-wheel or pen assembly to the cord. Be sure that the print wheel or pen is correctly zeroed by turning the main drive gear by hand until it hits the low stop. Center the pen or print wheel exactly on the lowest division of the chart (usually zero) and clamp the drive cord securely. (See Par. E. page 6).

J. Changing Chart Speeds

To change the chart speed on a Bristol Widestrip Dynamaster, first remove the change-gear lock nuts and the change gears from their shafts. (See Fig. 9).

Find the chart-drive motor behind the chart plate and determine the make and speed of the motor from its nameplate. The nameplate is located on the end of Telechron motors and on the top of Holtzer Cabot motors.

Find the column for the particular motor you have in the table Fig. 21 of Parts List P12055-A. Read down that column to find the desired chart speed; then read across the table to the right to find the gear train required.

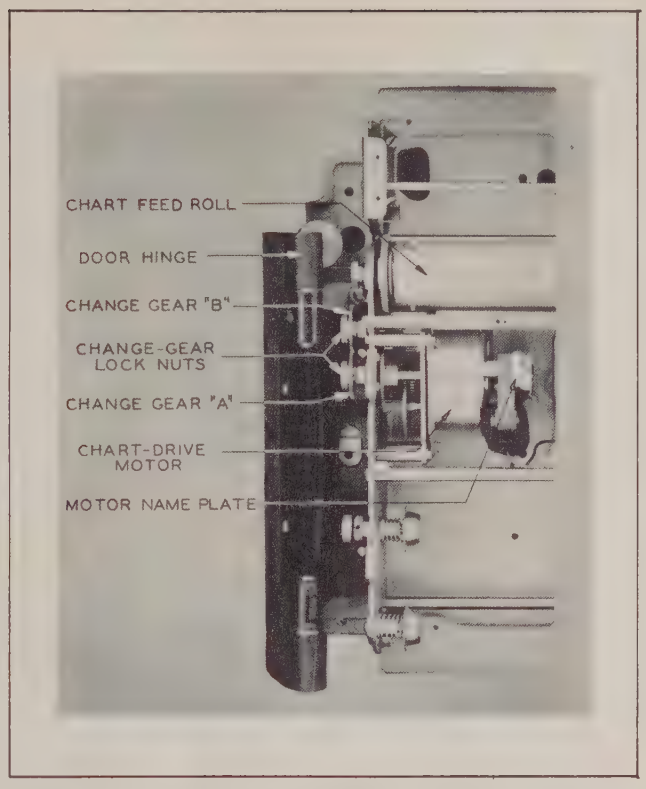


FIGURE 9. LEFT SIDE OF HINGED PANEL WITH CHART PLATE REMOVED

The number of teeth and the pitch should be marked on all gears with 32 or more teeth. If two gears with the same number of teeth are not marked for pitch, the smaller one is 48 pitch.

Put the gears on their respective shafts, making sure the "A" gear goes on the lower shaft. Be sure the slots in the gears engage the keys on the hubs so that they will not slip. Lock them in place with the change-gear lock nuts.

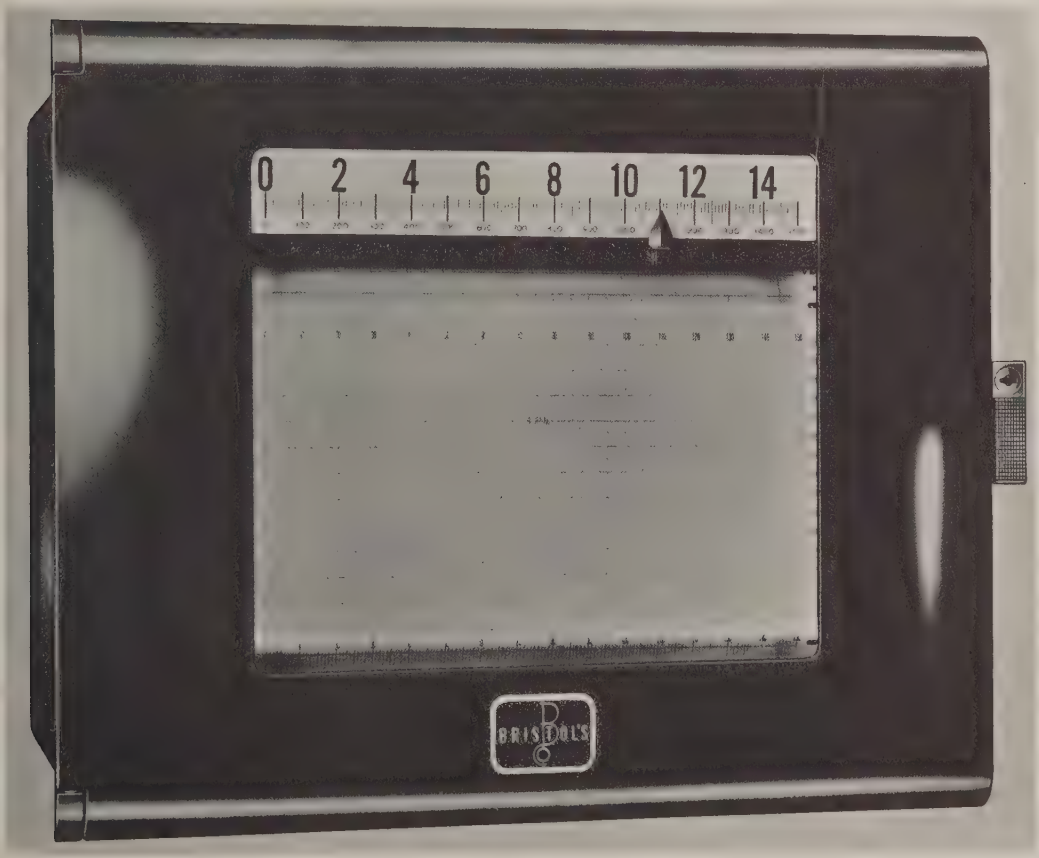
Note: If there do not appear to be enough gears for all the desired chart speeds, remember that each set of gears will give two speeds, depending on which gear is used as the "A" gear.

Spare chart-drive change gears are mounted on a stud located on the back of the hinged panel (upper left corner).

Instruction P12050-A
Issue of July 1961

INSTRUCTION NO. P12050-A
OPERATION AND SERVICE
BRISTOL'S® MODEL 560 WIDE-STRIP
DYNAMASTER® D-C POTENTIOMETER AND D-C BRIDGE

(WITH SPDT SYNCROVERTER SWITCH AND REFERENCE VOLTAGE SOURCE)



THE BRISTOL COMPANY WATERBURY 20, CONNECTICUT

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Note: This instruction covers the basic balancing and amplifying systems in the Bristol Series 560 Single- and Multiple-point Wide-strip Dynamaster D-C Potentiometer and D-C Bridge-type Instruments. See separate instructions covering case installation, recording system, measuring elements, controls, etc.

PART I GENERAL

A. Description

The Dynamaster potentiometer is used with any millivoltage input such as that from thermocouples, photoelectric cells, shunts, magnetos, pH amplifiers, etc.

The Dynamaster d-c bridge is used with a very low range resistance type of measuring element, such as resistance-thermometer bulbs, strain gauges, etc.

A single variable is accurately measured and recorded as a line record on the chart of the single-point recorder. As many as 24 variables may be recorded on the chart of the multiple-point recorders.

The major components of the instrument are:

1. The potentiometer circuit or bridge circuit
2. The Syncroverter switch
3. The input transformer
4. The amplifier
5. The balancing motor
6. The recording system
7. The multiple-point switching system (used only in the multiple-point recorders)

B. Explanation of Operation

1. The Dynamaster D-C Potentiometer. (See Figure 2) A millivoltage input from the measuring element is connected in series with the potentiometer circuit and Syncroverter switch. There is a standard voltage in the potentiometer circuit which is automatically adjusted to balance any change in the millivoltage input. Any change in the measuring-element voltage creates a d-c voltage unbalance in the potentiometer circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by an input transformer before being amplified by the electronic amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slide wire to restore electrical balance in the potentiometer circuit and simultaneously moves the indicating pointer and pen or print wheel to indicate and record, on the chart or scale, the value of the variable being measured.

This balancing action starts with the slightest change in the output voltage of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire potentiometer remains at rest until another change in the measured variable occurs.

2. The Dynamaster D-C Bridge. (See Figure 3) The measuring element forms one leg of the d-c bridge. A d-c power pack supplies 7 to 9 volts d-c to the bridge circuit. When the resistance of the measuring element changes, current flows in the bridge and a d-c voltage unbalance is created in the bridge circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by an input transformer before being amplified by the electronic amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slide wire to restore electrical balance in the bridge circuit and simultaneously moves the indicating pointer and pen or print wheel to indicate and record, on the chart or scale, the value of the variable being measured.

This balancing action starts with the slightest change in the resistance of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

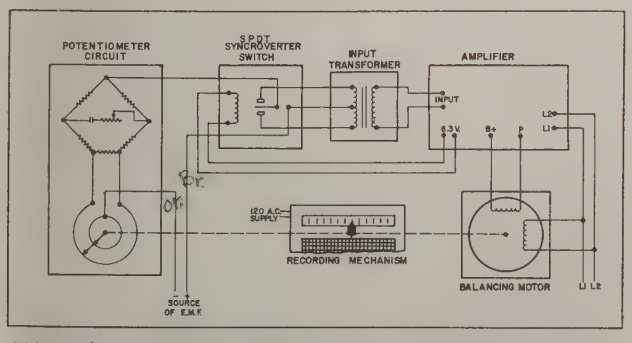

FIGURE 2. SIMPLIFIED SCHEMATIC WIRING DIAGRAM OF DYNAMASTER POTENTIOMETER

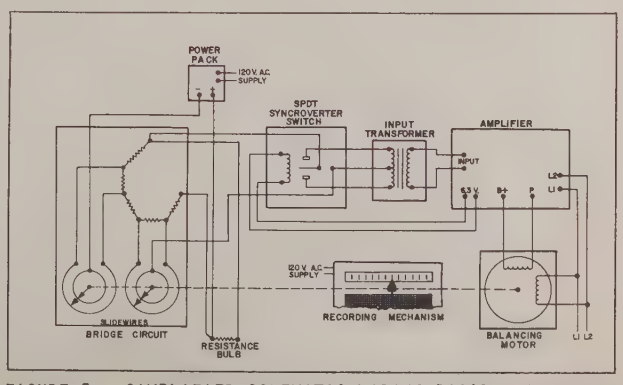

FIGURE 3. SIMPLIFIED SCHEMATIC WIRING DIAGRAM OF DYNAMASTER D-C BRIDGE

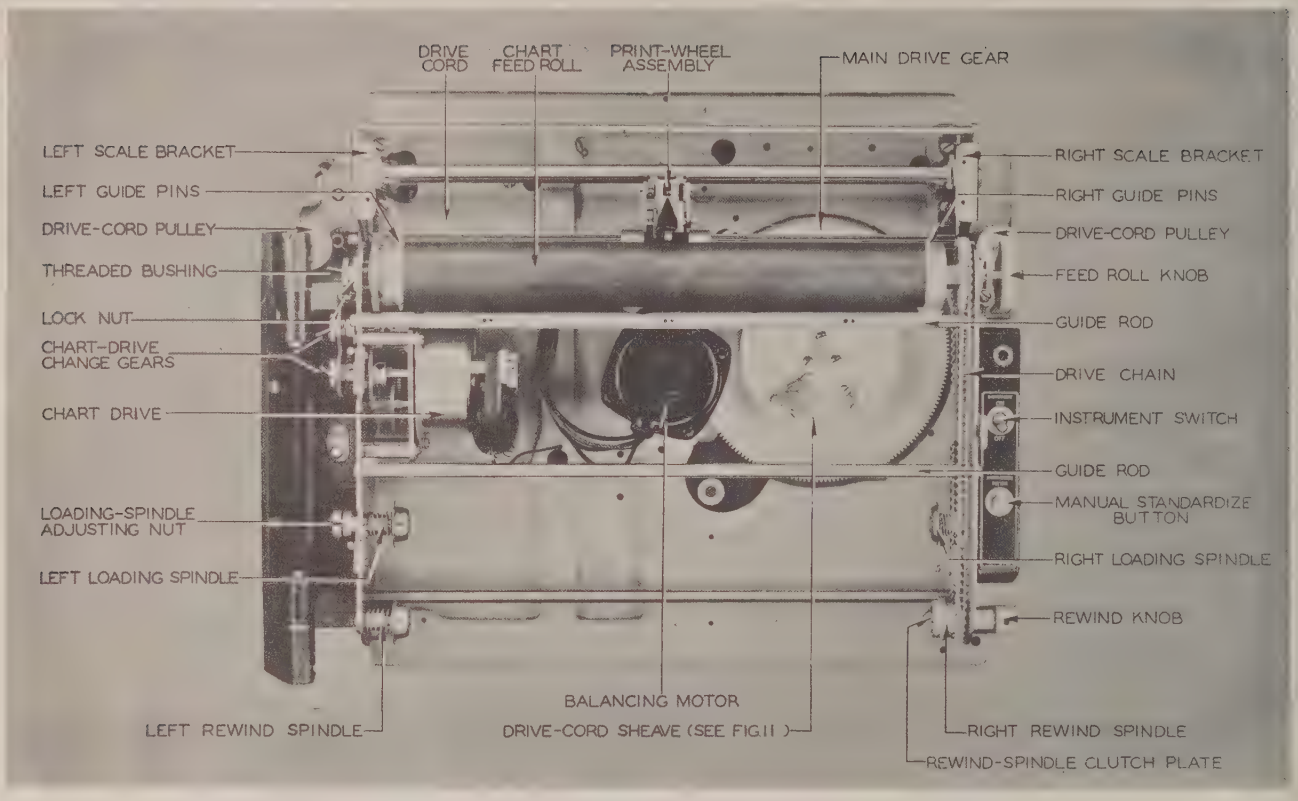

FIGURE 4. FRONT OF PANEL, MULTIPLE-POINT DYNAMASTER POTENTIOMETER

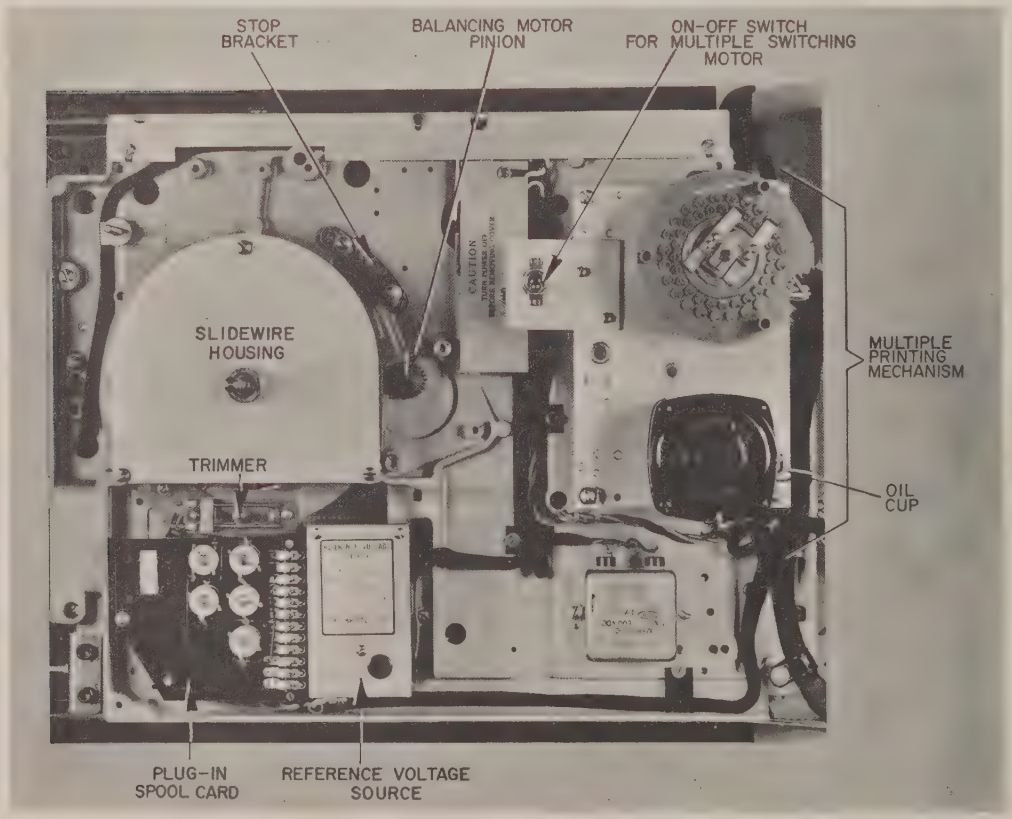

FIGURE 5. BACK OF PANEL, MULTIPLE-POINT DYNAMASTER POTENTIOMETER

When balance has been restored, the entire bridge remains at rest until another change in the measured variable occurs.

3. Other Variations. See separate instructions for other variations of measuring circuits.

PART II OPERATION

A. Starting the Dynamaster

To start the Dynamaster after it has been completely and correctly wired, simply turn on the instrument on-off switch. Nothing further need be done. If your Dynamaster is equipped with a control unit or other accessory, see separate instructions provided for its operation.

B. Stopping the Dynamaster

To stop the Dynamaster, merely turn off the instrument on-off switch. For a prolonged shutdown, the instrument should be stored in a clean, dry place.

C. Reference Voltage Source

The Bristol Zener Diode Reference Voltage Source, used on all d-c potentiometers is an accurate d-c voltage source with a high degree of stability and reliability. It utilizes Zener diodes as the reference elements in the preregulating and output stages of the regulating circuit.

This unit is factory adjusted to produce 1.0190 volts across the bridge circuit. Normally, no additional adjustment should be required. If it is desired to check the output voltage, it should be done with the load of the bridge circuit disconnected at the reference voltage source output terminal block, and a load of 339.67 ohms substituted across the terminals as equivalent to the proper bridge load.

The check should be made by balancing against a potentiometric test set. If the voltage is not within tolerance, remove the black snap-in plug in the cover below the name plate and adjust the potentiometer to produce the correct output voltage. Replace snap-in plug after any adjustment.

D. Amplifier Gain Adjustment

1. On Single- and Two-pen Recorders. The only time the amplifier gain adjustment need be checked is after changing tubes or doing other service work on the amplifier, and about once every 3 to 6 months thereafter. The reason for the periodic check is because the vacuum tubes age with use. While this check is being made, the measured variable should be at a steady value.

To check amplifier gain, proceed as follows:

Allow amplifier to warm up for at least 2 minutes. Remove the cap on the gain adjusting screw (see Figure 7 or 9). Turn the balancing-motor pinion (drive gear) manually to the right and release it. Then turn pinion to the left and release it. The pen should return quickly to its original position each time. If it does not return to its original position completely and quickly, it indicates that the amplifier gain (or sensitivity) is too low. To increase the gain, turn gain adjusting screw in a clockwise direction. When the gain adjustment has reached its maximum clockwise direction, the amplifier lacks sensitivity and requires new tubes.

There is an optimum position for the gain control. If the gain is too low, the pen will not return quickly to its proper value when the balancing motor is manually shifted off balance. If the gain is too high, the pen may "hunt" (mechanical oscillation of the pen). On some instruments if an abnormal pickup in the external measuring circuit is present, it is possible to turn the gain high enough to overload the amplifier and cause the balancing motor to act sluggishly. This condition can be corrected by reducing the gain (turning gain adjustment counterclockwise).

2. On Multiple-point Recorders. The gain adjustment on multiple-point recorders is made in the same manner as on single-pen recorders except that the motor on the multiple-switching mechanism must be stopped during this adjustment.

Present instruments are provided with a switch, mounted immediately below the switching mechanism, to cut the power to switching motor.

On instruments without a switch, the power may be broken by disconnecting the gray lead from the switching motor. Be sure to turn off the instrument power supply before disconnecting this lead.

PART III SERVICE

Service to the Bristol Dynamaster requires complete familiarity with the instrument. Other than routine preventive maintenance should be done only by a qualified technician, or the instrument should be returned to The Bristol Company for service. For routine maintenance on the instrument see Instruction No. Y19820.

A. Suggested Service Equipment

1. Stock of Replacement Parts. It is suggested that the following replacement parts be kept in stock. The vacuum tubes listed below are standard types and are available at any radio supply store:

Type 6X5 rectifier tube

Type 6V6 power amplifier tube

Type 7F7 voltage amplifier tube

Plug-in-type electrolytic filter capacitor with octal base (10-10-10 mfd. 450 volt)
Note: Electrolytic capacitors deteriorate in storage. Their shelf life should not

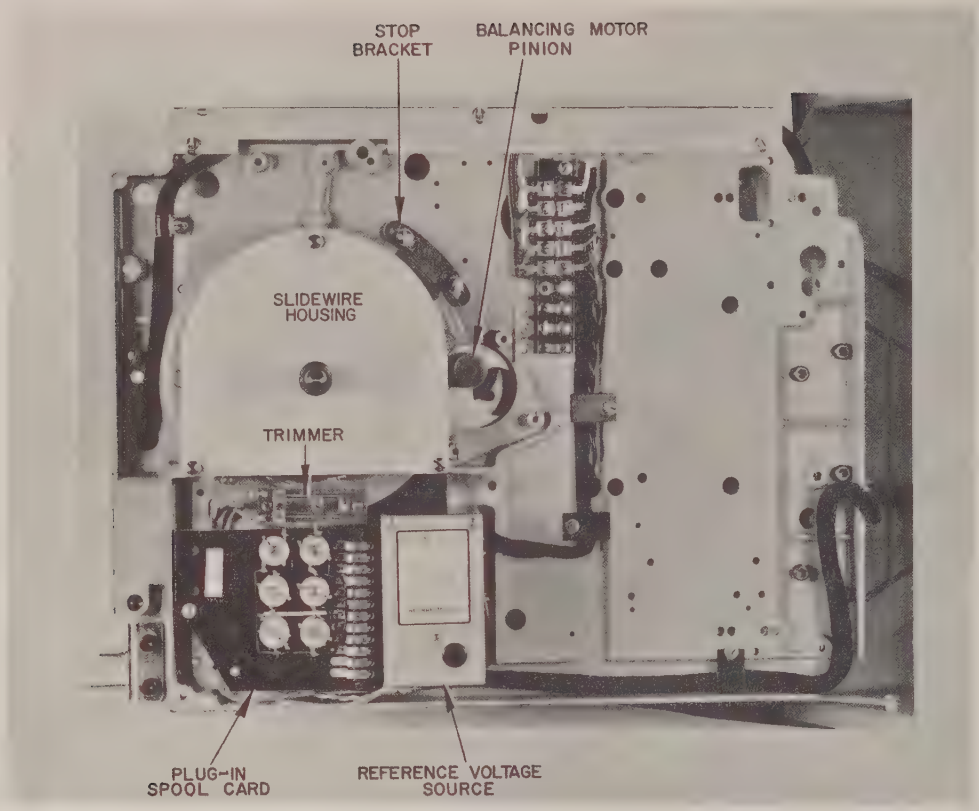

FIGURE 6. BACK OF PANEL, SINGLE-POINT DYNAMASTER POTENTIOMETER

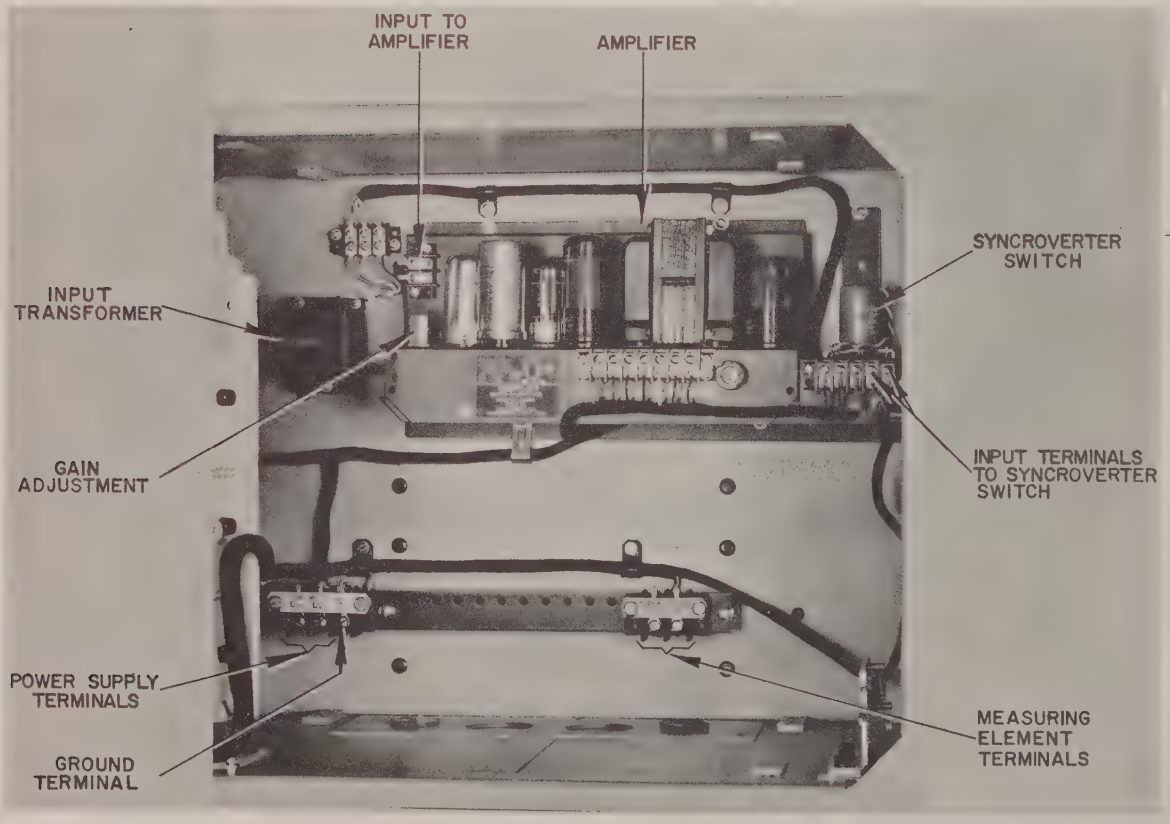

FIGURE 7. INTERIOR OF CASE

be over 18 months. Replacement electrolytic capacitors can be kept in usable condition indefinitely by placing them in service in the Dynamaster for an hour or two every six months.

Fuses for amplifier (1/8-ampere Littlefuse for series C-1 amplifier).

Amplifier. Where several Dynamasters are in use or where continuous instrument performance is of critical importance, it is recommended that space replacement amplifiers be kept in stock.

Pen for single-pen recorders

Pens for two-pen recorders

Inked felts for multiple-point recorders

2. Test Equipment

A signal generator, such as Bristol's Dynaprobe Part No. C-1038, is highly recommended because it provides a quick means for isolating trouble in the detection circuit of the Dynamaster without having to remove the Dynamaster from service or disconnecting the input circuit or the power to the instrument.

The Bristol Dynaprobe test unit is a compact signal generator designed for use with the Bristol Dynamaster.

The Dynaprobe consists of a covered metal box with a 2-foot cable with test probes and an additional extension with lugs at the end. The box has a toggle switch to provide either a 10 millivolt d-c signal or a 30 millivolt a-c signal as required. The back of the box is fitted with two prongs and two spring type connectors to permit plugging the unit into the power terminal block of the Dynamaster.

The Dynaprobe is also equipped with a receptacle to provide 120 volts a.c. for a soldering iron.

An **a-c voltmeter** or **test lamp** is required to perform the power-supply check.

An **ohmmeter** is convenient when checking the continuity of the measuring system.

On potentiometer-type instruments, a **potentiometric test set** is required (one with ranges 0 to 150 millivolts and 0 to 1.5 volts).

On d-c bridge-type instruments, a set of **test resistance spools** is handy for checking resistance measuring instruments. The Bristol Company manufactures a set of very accurate test resistance spools. Spools may be ordered by the set or singly for any value. Ordinary variations in room temperature do not affect their accuracy.

B. Systematic Trouble-shooting Procedure

Should the Dynamaster fail in any way, it is first necessary to determine which part is faulty. The following systematic procedure is suggested in order that repairs may be accomplished with a minimum of lost time and expense.

1. Power-supply Check. Using a 150-volt-range a-c voltmeter (or test lamp), check for line voltage across instrument power terminals, instrument power switch, L_1 and L_2 terminals on back of swinging panel, and also L_1 and L_2 terminals on amplifier.

2. Balancing-motor Check

Caution: Always be sure to turn power switch off before shifting the two control-winding wires because of the high voltage (300 volts) across terminals M_1 and M_2.

On instruments with **the Series C-1 or C-3 amplifier.** Turn off power switch. Remove the two control-winding wires from terminals M_1 and and M_2. Connect the wires across terminals L_1 and L_2. Add a 1-microfarad capacitor in series with the black wire from the motor. Turn on power switch. The motor should move the pen up or down-scale (depending upon phase). Next, reverse these wires from the control winding. The motor should move the pen in the opposite direction. If the balancing motor fails to move the pen up or downscale with the above test, it could mean that one of the following conditions exists:

1. No power to balancing motor.
2. Balancing motor defective.
3. Mechanical failure between balancing-motor pinion, bull gear and recording-pen shaft.

3. The Amplifier. Plug Dynaprobe into terminal block and with toggle switch in a-c position, apply test prongs across the input terminals of the amplifier (see Fig. 9). If amplifier is working properly, the balancing motor will move the pen up or downscale (depending upon phase). Reversing the two test prongs will cause the balancing motor to move the pen in the opposite direction. If the balancing motor does not move the pen up or downscale, disconnect the input leads to amplifier and check again with the test prongs across input terminals to amplifier. If the balancing motor still does not move the pen up or downscale, check fuse in amplifier, replace vacuum

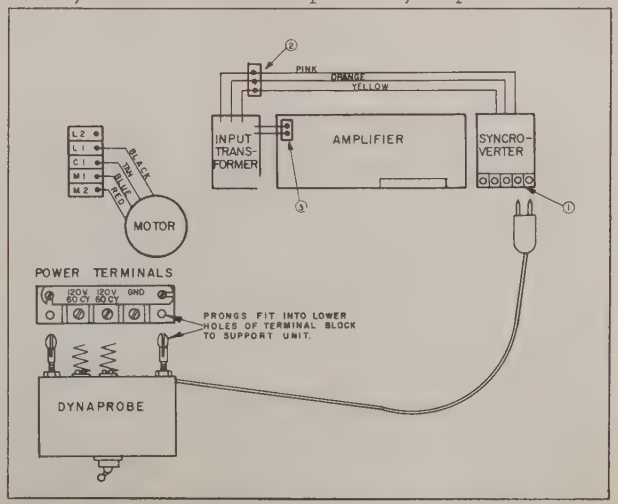

FIGURE 8. SKETCH SHOWING CHECK POINTS IN DYNAMASTER FOR DYNAPROBE

tubes and filter capacitor in amplifier. If this does not work, replace the amplifier.

Note: The Bristol Company recommends that service work inside the amplifier chassis should not be attempted by the average user. Service work on electronic circuits is a specialized technique requiring special test equipment for efficient results. For users having available an electronic technician and adequate test facilities, The Bristol Company has prepared service instructions for the amplifier which contain a detailed circuit diagram, testing data and procedure for checking the amplifier. A copy of this instruction is furnished with each Dynamaster.

4. Input Transformer. With toggle switch in a-c position, apply test prongs from Dynaprobe to input terminals of input transformer (pink and orange wires). If input transformer is O.K., the balancing motor will move the pen or print wheel up or downscale (depending upon phase). Reversing the test prongs will cause the balancing motor to move the pen or print wheel in the opposite direction. If the balancing motor does not move the pen or print wheel up or downscale, disconnect the input leads to transformer and check again with the test prongs across input terminals to transformer. If pen or print wheel still does not move up or downscale with this test, the input transformer is defective and should be replaced.

5. Syncroverter® Switch. (See Fig. 7). With the toggle switch on Dynaprobe in d-c position, apply test prongs to input terminals of Syncroverter switch (orange and brown wires). If Syncroverter switch is functioning correctly, the balancing motor will move the pen or print wheel up or downscale (depending upon phase). Reversing the test prongs will cause the balancing motor to move the pen or print wheel in the opposite direction. If the balancing motor does not move the pen or print wheel up or downscale, disconnect the orange and brown wires from Syncroverter switch and check again with the test generator. If the balancing motor still does not move the pen or print wheel up or downscale with this test, the Syncroverter switch is defective and should be replaced.

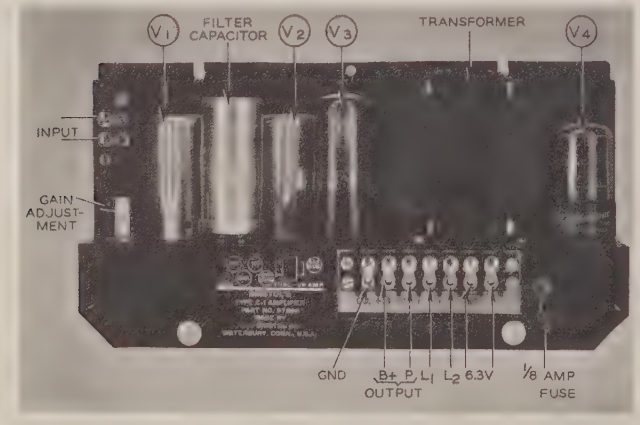

FIGURE 9. SERIES C-I AMPLIFIER

If steps 1 thru 5 have been performed and all of the components function correctly but the instrument still fails to function, the fault probably lies in the measuring system of the instrument.

6. Measuring System on Potentiometers. The potentiometer type of Dynamaster uses the null-balance potentiometer circuit. From the simplified schematic wiring diagram (Fig. 2) it will be noted that the measuring element is wired in series with the potentiometer circuit, Syncroverter contacts and primary winding of the input transformer. This means that an open circuit anywhere in the measuring circuit, slidewire, Syncroverter contacts or primary winding of the input transformer will produce the same result: no error signal in the circuit and consequently no output from the amplifier to the balancing motor.

Check carefully the particular measuring element used to see that it is functioning correctly. Check particularly the wiring connections at both the measuring element and the instrument. Disconnect the measuring-element leads from the instrument and connect them to a potentiometric test set to be sure that the measuring element is producing the voltage required for the existing conditions. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the Syncroverter switch. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

Check to see that the slidewire brush arm makes good contact with the slidewire. Try cleaning slidewire with Inhibisol or other solvent. Allow to dry. Then apply a small amount of Cramolin to slidewire and wipe off excess with a clean cloth.

Caution: If any solvent other than Bristol's cleaning fluid is used to clean slidewire, it must be a type that will not leave a residue or one that attacks varnish.

If the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

7. Measuring System on D-C Bridges. From the simplified schematic diagram (Fig. 3) it will be noted that the measuring element is wired so as to form one leg of the bridge. An open circuit anywhere in the bridge will produce

an infinite resistance, driving the pen or print wheel to the top or bottom of the chart depending upon what portion of the bridge is open-circuited. If an open circuit is suspected, it can easily be checked with an ohmmeter. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the Syncroverter switch. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

a. Check output voltage of power pack (7 to 9 volts d.c).

b. Check to see that the slidewire brush arm makes good contact with the slidewire. Try cleaning slidewire with Inhibisol or other solvent. Allow to dry. Then apply a small amount of Cramolin to slidewire and wipe off excess with a clean cloth.

If all of the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

8. The Recording System. The recording system is mechanical. It includes the chart drive and its gear train, chart feed roll, pen or print wheel drive cord and pulleys, etc.

Check the recording system for mechanical troubles, such as loose or binding gears, pulleys and fittings, etc. Move the pen or print wheel up and downscale manually by turning the main drive gear (with power off). It should move freely from one end of the scale to the other.

Feed the chart manually by turning the feed-roll knob counterclockwise. The tension of the feed-roll clutch should be felt, but the chart should feed straight and smooth without tearing or distorting the holes. The pen or print wheel should make a clean, legible record.

See separate instructions on the servicing of the recorder system.

9. The Switching Mechanism. On instruments that have a multiple-switch operating spring such as illustrated in Figure 5, it may be necessary to increase the spring tension. The need for this will be indicated by indiscriminate or random printing of some or all of the records on the chart. To increase the spring tension, move the spring adjusting link to the next hole.

C. Miscellaneous Trouble-shooting Tips

In general, the following symptoms of troubles described below are caused by definite faults.

For all failures not specifically described below, follow the systematic trouble-shooting procedure outlined in Paragraph B, page 7.

1. Symptoms: Pen or print wheel remains stationary regardless of changes in the value of the measured variable.

Possible faults:

a. Defective line fuses

b. Power failure

c. Defective amplifier fuse. An amplifier fuse which burns out repeatedly generally indicates a bad rectifier tube or filter capacitor (plug-in capacitor).

d. Defective tube in amplifier

e. Defective filter capacitor

f. Open circuit in measuring element

g. Syncroverter-switch failure

h. Defective balancing motor

2. Symptom: Pen or print wheel records incorrect values.

Possible faults:

a. Defective measuring element

b. Incorrect gain adjustment

3. Symptom: Chart does not feed properly.

Possible faults:

a. Chart is not lined up properly

b. Feed-roll clutch is slipping

4. Symptom: Chart speed is incorrect.

Possible faults:

a. Wrong change gears

b. Defective motor

c. Frequency of power supply incorrect

D. Repairs, Correspondence and Shipping

If the Dynamaster cannot be repaired with the information furnished in this instruction, it should be shipped to the nearest Company Branch or Main Factory for repair or replacement. Do not ship instruments to Branch Offices. Be sure to mark your return address plainly.

In all correspondence please mention the instrument model and serial number (as listed on its nameplate) and your repair order number. Address all correspondence to the Bristol Company branch or Main Offices, a list of which is found in all instruction manuals.

The Bristol Company
Waterbury 20, Conn.

Printed in U.S.A.

SERIES D
P/N C1096

Instruction No. P12072
Issue of September 1961

INSTRUCTION NO. P12072

(Replaces issue of 2/61)

SERVICE INSTRUCTIONS

FOR THE SERIES C-1, C-3 & C-4 AMPLIFIERS

PART I INTRODUCTION

This instruction covers the service of the Series C-1, C-3 and C-4 amplifiers used on Bristol Dynamaster (Models 560, 565 etc.). The Series C-1 amplifier is for use of a 120 v. 60 cy. supply. The Series C-3 is for use on a 120 v. 60 cy. supply and a Dynamaster with attachment T100 (auxiliary gain adjustment). The Series C-4 amplifier is for use on a 120 volt, 50 cy. supply.

Service work on electronic circuits is a specialized technique requiring special test equipment. Only a qualified electronic technician should attempt service inside the amplifier chassis. If a qualified technician is not available, the amplifier should be returned to the nearest Bristol Company Branch or Main Factory for repair. Adequate stocks of guaranteed, factory-rebuilt exchange amplifiers are maintained at several points throughout the country to assure fast replacement. Contact nearest Bristol office as listed on last page of all instruction books.

PART II TEST EQUIPMENT

Multirange volt-ohmmeter with ranges 0 to 50 and 0 to 500 volts d-c, 0 to 4000 and 0 to 500,000 ohms resistance, voltage sensitivity 20,000 ohms per volt.

A signal generator, such as Bristol's Dynaprobe Part No. C1038, is recommended for producing a test input signal. Figure 1 illustrates how a signal generator can be made.

Cathode-ray oscilloscope with an input impedance not less than 500,000 ohms and a vertical sensitivity of .03 volts.

PART III TEST PROCEDURE

Disconnect all leads to amplifier and remove amplifier from Dynamaster. The amplifier may be removed by loosening the rear mounting screws and unlocking the quick fasteners on the front of the chassis.

Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

Caution: Never check an amplifier without first connecting the 5000-ohm resistor across the output terminals of the amplifier.

Connect the 120-volt power supply to power terminals marked L_1 and L_2. This

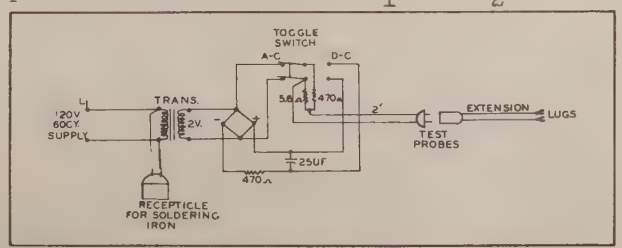

FIGURE 1. WIRING OF TEST INPUT-SIGNAL GENERATOR

Measure From	Measure To	Correct Voltage	Recommended Correction If Voltage Is Too Low	Recommended Correction If Voltage Is Too High
B+	Gnd.	360 ± 10	Replace V_4 & plug-in capacitor No voltage. Replace fuse.	Replace V_3
B_5	Gnd.	355 ± 10	Replace plug-in capacitor	Replace V_3
B_4	Gnd.	330 ± 10	Replace plug-in capacitor	Replace V_1 or V_2
B_3	Gnd.	260 ± 10	Replace plug-in capacitor	Replace V_1 or V_2
S_c	Gnd.	335 ± 10	Replace V_3	Replace V_3 Check R_{23}
B_{1-2}	Gnd.	220 ± 10	Replace plug-in capacitor Check C_{21}	Replace V_1
P_5	Gnd.	240 ± 10	Check voltage at B_5	Replace V_3
P_4	Gnd.	290 ± 10	Check voltage at K_4	Check R_{19}
P_3	Gnd.	145 ± 10	Check voltage at K_3	Check R_{15}
P_2	Gnd.	115 ± 10	Check voltage at K_2	Check R_7
P_1	Gnd.	115 ± 10	Check voltage at K_1	Check R_3
K_5	Gnd.	24 ± 3	Check C_{16}	Check R_{23}
K_4	Gnd.	4.8 to 5.7	Check C_{13} & R_{19}	Check R_{18}
K_3	Gnd.	2.3 ± 0.5	Check C_{10}	Check R_{14}
K_2	Gnd.	1.8 ± 0.5	Check C_4	Check R_6
K_1	Gnd.	1.8 ± 0.5	Check C_1	Check R_2
Note: Points K_1, K_2, etc., were marked C_1, C_2, etc., on earlier models.				

FIGURE 2. TABLE OF D-C VOLTAGE CHECKS BASED ON A LINE VOLTAGE OF 117 VOLTS AND A 5000-OHM 10 WATT RESISTOR ACROSS THE OUTPUT TERMINALS OF AMPLIFIER

is the nominal operating voltage and any variation from it will produce slightly lower or higher test readings.

Warning: There are dangerous voltages in the amplifier. Never touch any part with bare hands unless the power is off.

A. D-C Voltmeter Check

A quick method of locating the defective stage is by the use of a d-c voltmeter.

With the amplifier removed from the instrument, proceed as follows:

1. Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Turn gain control to zero (extreme counterclockwise position).

4. Connect negative lead of voltmeter to the ground connection on the amplifier. Test with the other voltmeter lead at the points listed in table, Figure 2.

The voltages given in the table (Figure 2) were taken with a 20,000 ohm per volt meter and with a line voltage of 117 volts. If the line voltage is greater or less than 117 volts, the d-c voltage given in the voltage table will vary proportionally. **For example:** If the line voltage is 110 volts, the B+ voltage instead of being approximately 360 volts will be $\frac{110}{117} = \frac{x}{360}$ or $x = \frac{110 \times 360}{117} = 338.$

Therefore, the B+ voltage will be approximately 338 volts with a line voltage of 110 volts.

For optimum damping and sensitivity, the voltage between K_4 and ground should not vary more than specified values.

All d-c voltages above 100 volts should not vary more than ±10 volts from specified values.

Voltages between K_1, K_2 and K_3 and ground should not vary more than ±0.5 volts from specified values.

Voltage between K_5 and ground should not vary more than ±3 volts from specified value.

If B+ is low, replace V_4. If B_3, B_4 or B_5 is low, replace the plug-in filter capacitor with one known to be good. This capacitor contains C_{18}, C_{19} and C_{20}.

B. Testing with an Oscilloscope

For those who desire to locate the defective stage by tracing a test input signal step by step thru the amplifier with an oscilloscope, the following procedure should be followed:

1. Connect a 5000-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Connect the a-c test input signal from the signal generator to the amplifier input terminals.

4. Turn the gain adjustment to its maximum position (extreme clockwise position).

5. Connect the ground side of the oscilloscope to the amplifier chassis ground.

6. Connect test voltage to the vertical input terminals (Y axis) of the oscilloscope. Then, adjust horizontal sweep rate, as required, until a sine-wave pattern appears on the scope. See also directions furnished with oscilloscope.

(G_1) **Signal:** Sine wave on screen. Note amplitude for comparison with the following tests.
No Signal: Check signal generator.

(P_1) **Signal:** Amplitude should be about 40 times G_1.
No Signal: Defect in first stage. Check V_1. Check voltage from K_1 to ground and P_1 to ground (see d-c voltage table, Figure 2).

(X_1) **Signal:** Same as P_1.
No Signal: Check C_2 and R_4.

(G_2) **Signal:** Slightly less than P_1.
No Signal: Check C_3, R_4 and R_5.

(P_2) **Signal:** Amplitude should be about 40 times greater than G_2.
No Signal: Defect in second stage. Check V_1. Check voltage from K_2 to ground and P_2 to ground (see d-c voltage table, Figure 2).

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(X_2) **Signal:** Amplitude about 1/5 that of P_2. If signal is abnormally high or low, check R_8, R_9, R_{10}, C_5, C_6, C_7 and R_{11}. If fault is found in this section, replace entire board or return amplifier to factory.

(X_3) **Signal:** Same as X_2.
No Signal: Check C_8 and R_{12}.

(G_3) **Signal:** Amplitude should be about the same as X_3.
No Signal: Check C_9 and R_{13}.

(P_3) **Signal:** Amplitude should be about 50 times G_3.
No Signal: Defect in third stage. Check V_2. Check voltage from K_3 to ground and P_3 to ground (see d-c voltage table, Figure 2).

(X_4) **Signal:** Same as P_3.
No Signal: Check C_{11} and R_{16}.

(G_4) **Signal:** Less than X_4.
No Signal: Check C_{12} and R_{17}.

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(P_4) **Signal:** Amplitude should be about 14 times G_4.
No Signal: Defect in fourth stage. Check V_2. Check voltage from K_4 to ground and P_4 to ground (see d-c voltage table, Figure 2).

(G_5) **Signal:** Approximately 1/4 that of P_4
No Signal: Check C_{14}, C_{15} and R_{21}.

(X_5) **Signal:** Same as G_5.
No Signal: Check R_{22}.

(P_5) **Signal:** Amplitude should be about 6 times G_5.
No Signal: Defect in fifth stage. Check V_3. Check voltage from K_5 to ground and P_5 to ground (see d-c voltage table, Figure 2).

(P) On terminal strip
Signal: Same as P_5.
No Signal: Check connections between P and P_5.

C. Identifying Defective Part

When the defective stage is located from the above checks, the defective part of that stage may be identified. This is

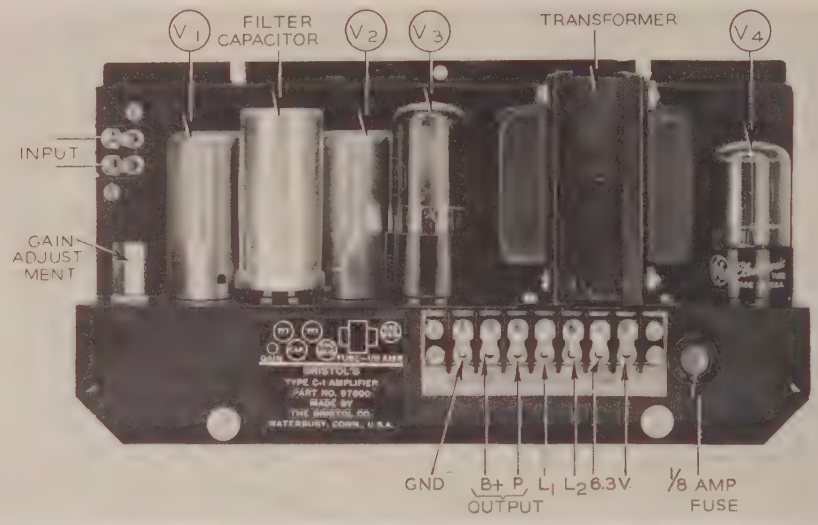

FIGURE 3. FRONT VIEW OF SERIES C-1 AMPLIFIER

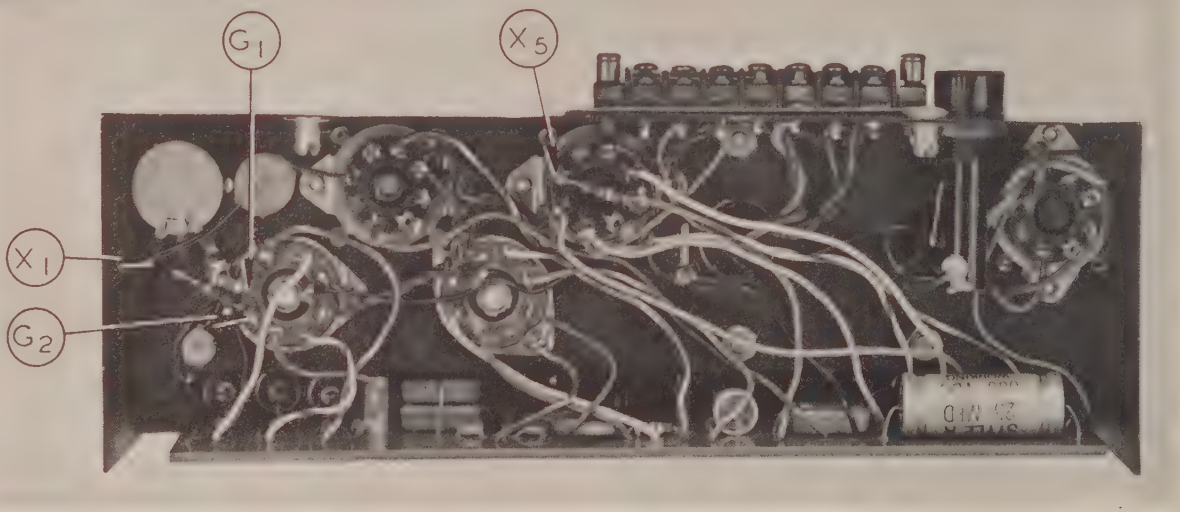

FIGURE 4. BOTTOM VIEW OF SERIES C-1 AMPLIFIER

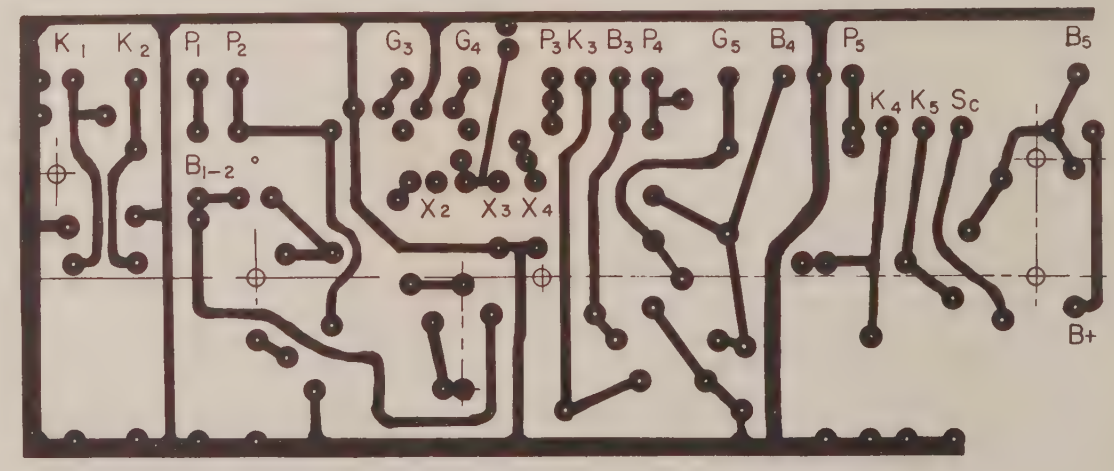

FIGURE 5. PRINTED CIRCUIT SHOWING TEST POINTS

done by checking with an ohmmeter the resistors of that stage. All ohmmeter checks should be made with the power off and the plug-in capacitor and vacuum tubes removed. If the resistors are correct, it can generally be assumed that a capacitor or capacitors associated with that section of the circuit are defective. Test them by replacement.

This systematic checking of each resistor and capacitor in the defective stage will quickly identify the defective part.

D. Calibration of Printed Circuit Board for Series C-1 and C-3 Amplifiers.

The printed circuit board contains 2 calibrating resistors, identified as R9 and R29 on the schematic drawings.

These resistors are part of a double T network designed to suppress any 120 cycle signal. The network is tuned at the factory and should never require any field attention. If the capacitors and resistors in this network are damaged in the field, we would recommend purchasing a printed circuit board complete with the components shown in figure 6.

If it is necessary to change one of the resistors or capacitors in this network in the field, it will be necessary to retune the network. To do this requires a 120 cycle oscillator, a sensitive a-c voltmeter or oscilloscope and 2 decade resistor boxes.

Connect the oscillator between P2 and ground. Set the oscillator at 120 cycles and apply 10 volts. **Caution:** Be sure that the amplifier is disconnected from the power lines at this time. Connect the sensitive a-c voltmeter or oscilloscope between X2 and ground. Connect a decade resistor box in place of R9 (10,000 to 150,000 ohms) and another in place of R29 (1000 to 15,000 ohms). Adjust resistors R9 and R29 until a minimum reading is obtained on the oscilloscope or meter. The suppression of 120 cycles in this filter should be between 300 and 1,000 to 1. This means that with a 10-volt input from the oscillator you should be able to reduce that signal to 33 mv. or less.

When the proper values for R9 and R29 are determined, obtain resistors of this value and install. These resistors should be wire wound with a tolerance of ± 10%.

NOTE: For series C-4 (50 cy.) amplifiers, the calibration is the same as above except that references to 120 cycles should be changed to 100 cycles.

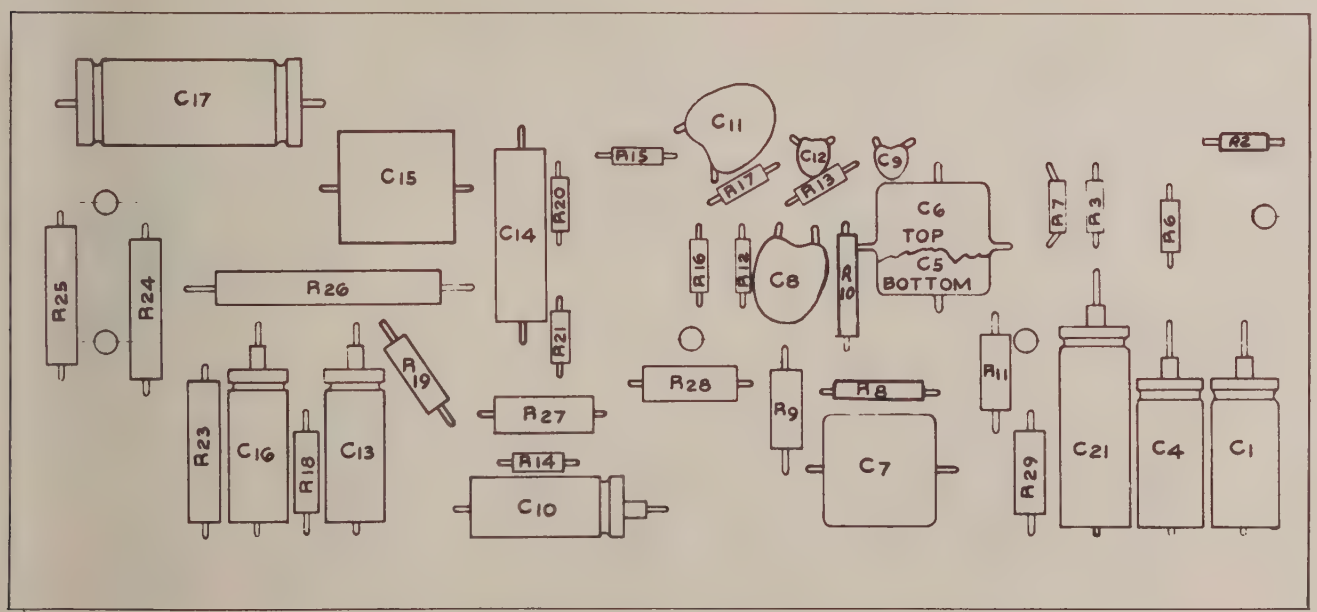

FIGURE 6. COMPONENT SIDE OF PRINTED CIRCUIT BOARD

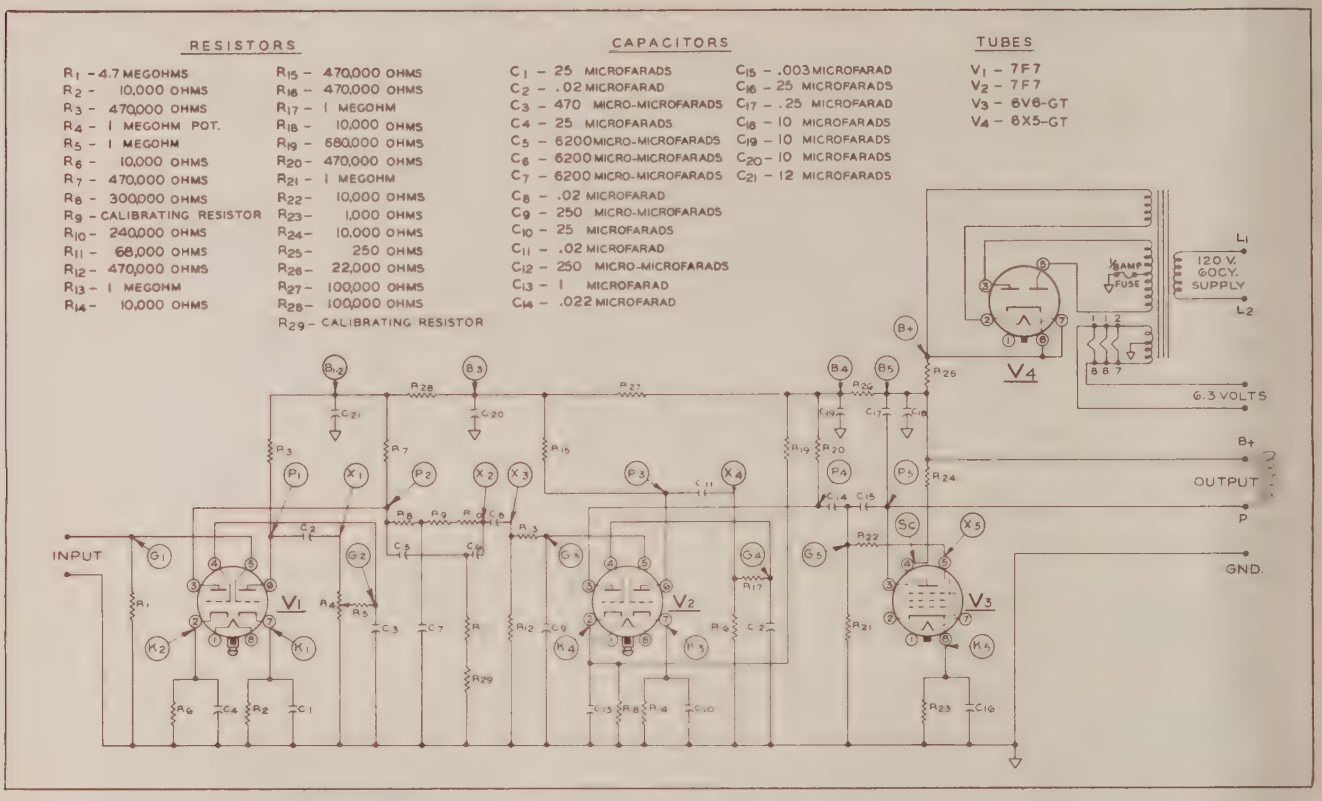

FIGURE 7. SCHEMATIC WIRING DIAGRAM SERIES C-1 AMPLIFIER

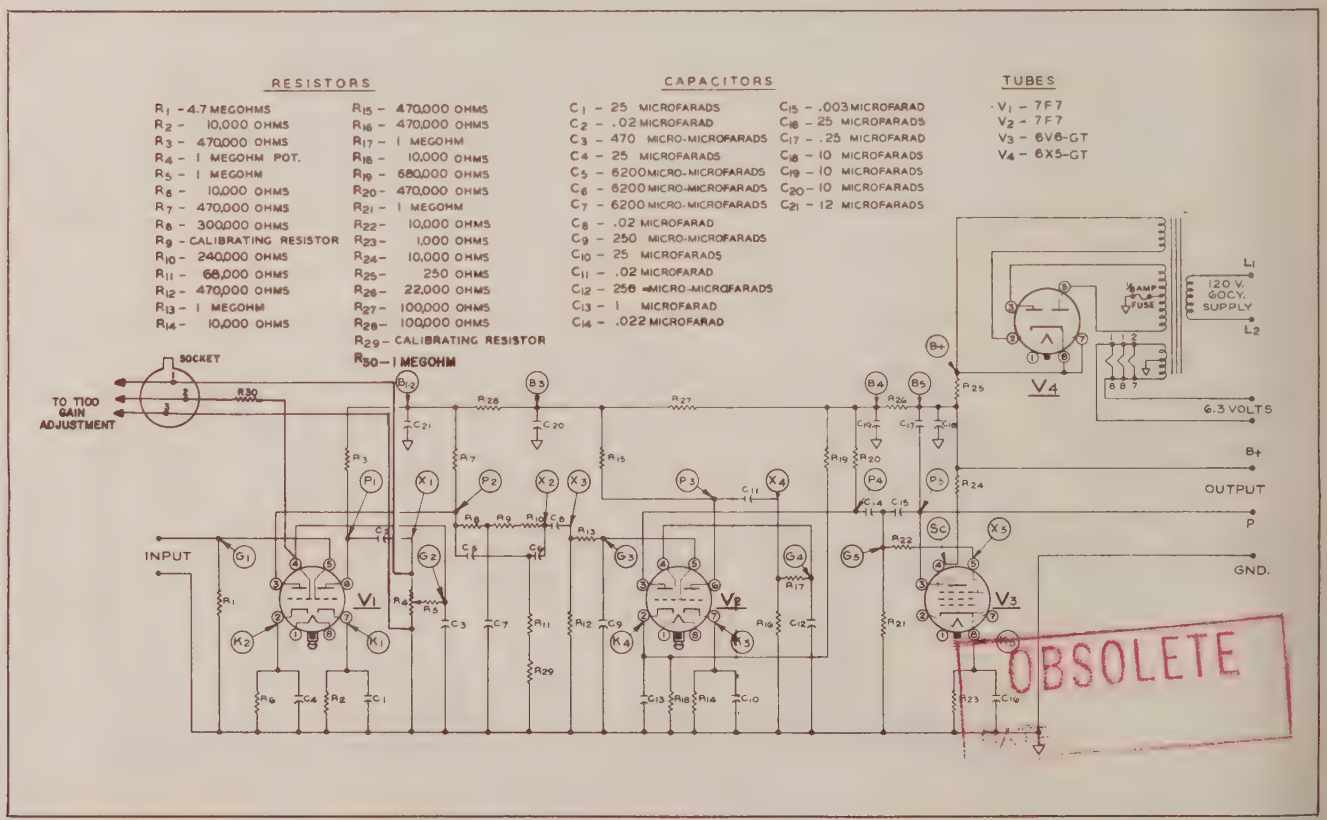

FIGURE 8. SCHEMATIC WIRING OF SERIES C-3 AMPLIFIER

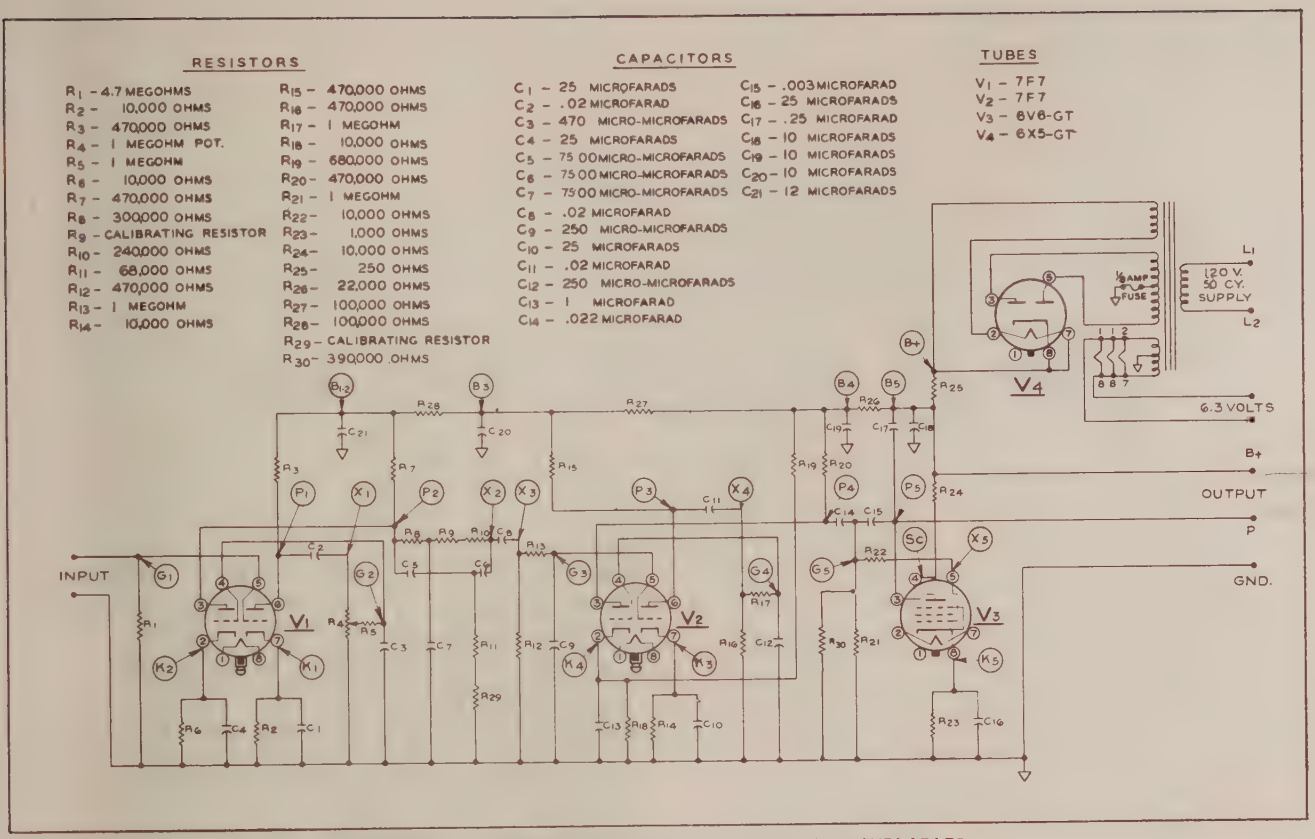

FIGURE 9. SCHEMATIC WIRING OF SERIES C-4 AMPLIFIER

The Bristol Company
Waterbury 20, Conn.

Printed in U.S.A.

PARTS LIST P12055-A
February 1961
Replaces Issue of 2/60

PARTS LIST

BRISTOL'S® MODEL 560 AND 570

WIDE STRIP DYNAMASTER RECORDER

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THE BRISTOL COMPANY WATERBURY 20, CONNECTICUT, U.S.A.

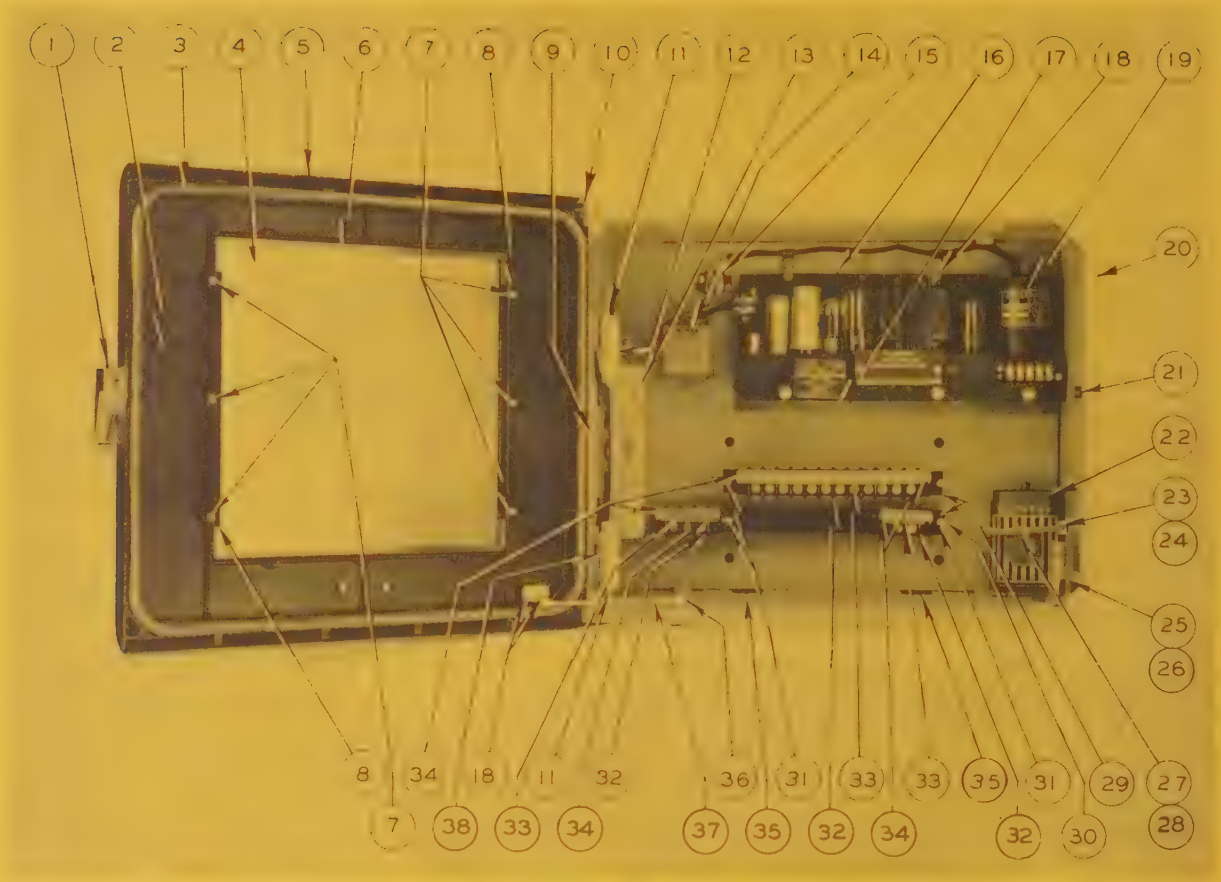

FIGURE 1. DOOR AND CASE INTERIOR

ITEM	PART NO.	DESCRIPTION
1	82615	Handle complete
	*87239	Stop pin
	*94738	Latch plate
2	88751	Hook complete
	82415	10-32 x 1/4" Bristo cup-point setscrew
	*82630	Flat spring
3	82608	Rubber gasket (62" long)
4	83644	Glass
5	85202	Door complete including items 1 thru 4 and 6 thru 8
	83057	Door only, order drilled per spec 85203
6	84725	Gasket (47" long)
7	82656	6 x 3/16" Self-tapping screw
8	85232	Glass clip
9	85236	Hinge bracket
	*66539	10-32 x 3/8" Fillister-head screw
	*66541	10-32 x 1/2" Fillister-head screw
	*82413	10-32 x 3/16" Bristo flat-point setscrew
10	82654	Door hinge
	*92693	10-32 x 7/16" Flat-head screw
11	85208	Hinge pin
12	12721	Washer
13	83996	Hinge for hinged panel on 1-pen and multiple-point instruments
	C1078	Hinge for hinged panel on 2-pen instruments
14		Input transformer
	82171	for 200,000 ohm input, 50-60 cycle
	92758	for 10,000 ohm input, 50-60 cycle
	91934	for 1,000 ohm input, 50-60 cycle
	94202	for 500 ohm input, 25 cycle
	92759	for 100 ohm input, 50-60 cycle
	*31427	6-40 x 5/16" Fillister-head screw
	*56498	Post
15	89131	Terminal block (2 point)
	*58073	6-40 x 7/16" Fillister-head screw

*Not Shown

ITEM	PART NO.	DESCRIPTION
16	90640	Series C amplifier for 50-60 cycles (see parts list P12075 for breakdown)
	93956	Series C amplifier for 25 cycles (see parts list P12075 for breakdown)
	97600	Series C-1 amplifier for 60 cycles (see parts list P12077 for breakdown)
	C1551	Series C-3 amplifier for 60 cycles. Used with attachment T100
	C1646	Series C-4 amplifier for 50 cycles
	C1648	Series C-5 amplifier for 60 cycles
	C1096	Series D amplifier for 60 cycles (see parts list P12077 for breakdown)
	C1552	Series D-2 for 60 cycles. Used with attachment T100
	C1650	Series D-3 for 50 cycles
17	89124	Amplifier shelf
	C1667	Amplifier shelf (C-5 only)
18	40066	8/32 x 1/4" Fillister-head screw
19	89189	Syncroverter switch
	C1668	Syncroverter used with C-5 amplifier
20		Case body complete (includes items 9, 21, 25 and 26)
	93999	for 560 single-pen and multiple-point instruments
	85201	560 case body only (drilled and tapped)
	95644	for 570 single-pen and multiple-point instruments
	95645	570 case body only (drilled and tapped)
	D1099	for 570 2-pen instrument
	D1098	570 case body only (drilled and tapped)
21	96126	Roller
	*96127	Roller stud
22	64933	Battery (1.5 volt)
	67489	Battery (6 volt)
	*86001	Battery pad (around battery)
	*88142	Battery pad (under battery)
23	85266	Spring bracket
24	18339	6-40 x 3/16" Fillister-head screw
25	85220	Latch complete for hinged panel
26	89659	1/4"-20 x 3/8" Hexagon socket-head cap screw
27	85297	Battery spring
28	86000	Battery-spring insulation tube
29	86092	Terminal mounting strap (11 7/8" long)
	86093	Terminal mounting strap (8 13/16" long)
30		Terminal strap mounting post
	34954	1/2" long
	88102	1 1/4" long
	88106	2" long
	89869	2 3/4" long
31		Terminal strap mounting screw
	66568	10-32 x 3/4" Flat-head screw
	66545	10-32 x 3/4" Fillister-head screw
	66572	10-32 x 1 1/2" Flat-head screw
	65984	10-32 x 1 1/2" Fillister-head screw
	66575	10-32 x 2 1/4" Flat-head screw
	88107	10-32 x 2 1/4" Fillister-head screw
	89870	10-32 x 3" Round-head screw
32		Terminal blocks
	74804	2 terminals
	87235	3 terminals
	87236	4 terminals
	93670	5 terminals
	87238	6 terminals
	76643	8 terminals
	85288	9 terminals
	88098	12 terminals
33		Terminals marking strip (give marking and number of terminals)
34	87936	#10 x 1" Self tapping screw
	*72166	Spacer
	*10075	Washer
35	86026	Rubber grommet (for 1 11/16" conduit hole)
	72691	Rubber grommet (for 1 1/16" conduit hole)
36	87392	Door-stop screw
	44739	Collar
37	86027	Door stop
38	30401	Washer
		Case mounting brackets
	*92030	Bracket
	*32193	1/4"-20 x 1/2" Hex-head screw for mounting bracket to case
	*83848	5/16"-24 x 2 1/2" Headless screw for flush-mounted case
	*50706	5/16"-24 Hex nut for screw 83848
	*92031	Cup washer for screw 83848

*Not Shown

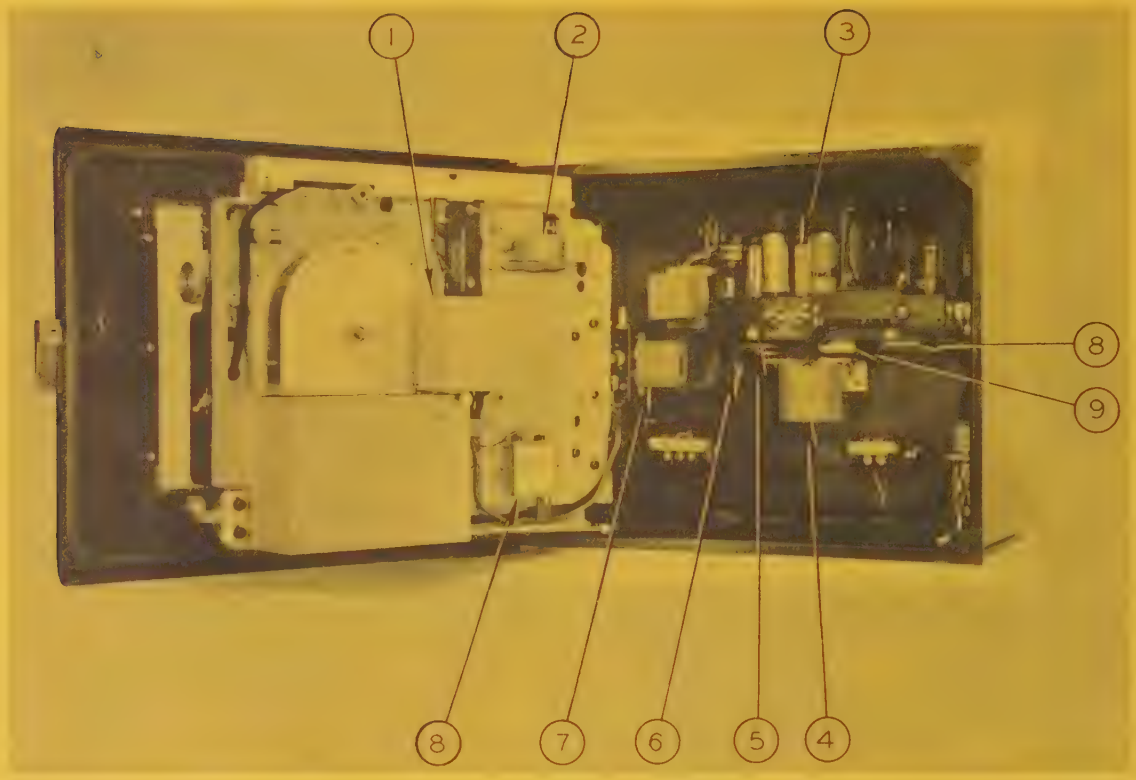

FIGURE 2. PHOTO OF HIGH-SPEED (0.4 SEC.) DYNAMASTER

ITEM	PART NO.	DESCRIPTION
1	82162	Feed-back generator complete (order assembled per sheet OC1042)
	A2231	Balancing-motor mounting plate
	26966	8-32 Hex nut for mounting balancing motor
	93325	Generator-plate mounting post
	A4988	Pinion and flexible coupling
	66562	10-32 x 3/8" flat-head screw for mounting generator plate
	93327	Adjustable plate for mounting generator motor
	66536	8-32 x 3/16" Fillister-head screws for mounting adjustable plate
	84190	Barber-Coleman motor (generator)
	93329	Generator cover post
	93328	Generator cover
	63382	5-40 x 3/16" Fillister-head screw for mounting cover
2	93347	Rectifier for pen-lifter relay
	*18339	6-40 x 3/16" Fillister-head screw for mounting rectifier
3	C1096	Series "D" amplifier (see parts list P12077 for breakdown)
4	92736	Output transformer
	*66537	10-32 x 1/4" Fillister-head screw for mounting transformer
	*35638	#10 Lockwasher
5	A3820	Thyrite disk complete
	*62290	6-40 x 1 1/16" Fillister-head screw for mounting Thyrite disk
	*43040	Washer
	*A2241	Spacer
	*20903	6-40 Hexagon nut
6	A2517	Stick resistor
	*92315	6-40 x 2" Fillister-head screw for mounting stick resistor
	*43040	Washer
	* 256	Retaining washer
7	B1216	Feed-back unit complete
	93307	Transformer
	91050	Rheostat (60 ohm)
	A2242	Rheostat (2 meg.)
	83979	Resistor (470K, 1/2 watt)
	90575	Resistor (10K, 1 watt)
	84549	Potentiometer cap
8	93740	Capacitor (1.25 mfd. 600 V.)
	*66537	10-32 x 1/4" Fillister-head screw for mounting capacitor
	*35638	#10 Lockwasher
9	74480	Capacitor (½ mfd. 600 V.)

*Not Shown

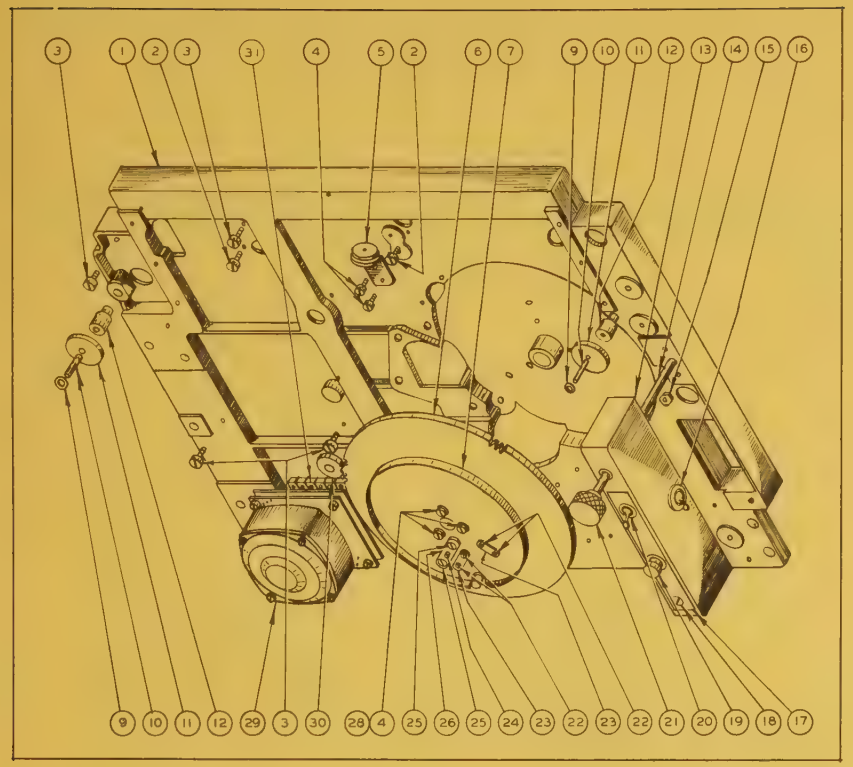

FIGURE 3. FRONT OF HINGED PANEL

ITEM	PART NO.	DESCRIPTION
1	98350	Mounting frame for 1-pen and multiple point instruments
	B1151	Mounting frame for 2-pen instruments
2	66539	10-32 x 3/8" Fillister-head screw
3	66539	10-32 x 3/8" Fillister-head screw for 2-pen instruments
	42098	10-32 x 7/16" Fillister-head screw for multiple-point instruments
4	31427	6-40 x 5/16" Fillister-head screw
5	88183	Pulley and bracket complete
	76283	Pulley
	79854	Retaining ring
6	92578	Bull gear complete for 3-, 4.5-, 7- and 24-second pen travel, includes setscrew and items 4, 7, 22 thru 26 and 28
	86052	Bull gear and hub only for 3-, 4.5-, 7- and 24-second pen travel
	93929	Bull gear complete for 1- and 0.4-second pen travel, includes setscrew and items 4, 7, 22 thru 26 and 28
	93360	Bull gear and hub only for 1- and 0.4-second pen travel
	89049	5/16-18 Flat-point setscrew
7	85255	Sheave
9	80607	Retaining ring (1/8" shaft) (see item 11)
10	85291	Pulley shaft (see item 11)
11	92579	Cord-pulley assembly complete including setscrew and items 9, 10 and 12 for 3-, 4.5-, 7- and 24-second pen travel
	A2205	Cord-pulley assembly complete including setscrew and item 12 for 1- and 0.4-second pen travel
	82403	Setscrew for item 11
12	85292	Mounting stud for 3-, 4.5-, 7- and 24-second pen travel (see item 11)
	A2210	Mounting stud for 1- and 0.4-second pen travel (see item 11)
13	86025	Switch housing for 1-pen and multiple-point instrument
	92934	Switch housing same as above, but drilled for 2-speed chart-drive switch
	A2066	Switch housing for 2-pen instrument
14	88175	Control-knob shaft
15	72055	10-32 Hexagon nut
16	62827	2-speed chart-drive switch
17	86098	Switch plate for d-c Potentiometer type instrument (2 switches)
	86099	Switch plate for a-c bridge type instrument (1 switch)
18	91089	6-40 x 1/4" Fillister-head screw
19	54261	Push-button switch
20	62182	Toggle switch (on-off)
21	89132	Control knob
	82413	10-32 x 3/16" Flat-point setscrew
22	39770	6-40 x 1/4" Fillister-head screw
23	85319	Cord clamp
24	76273	Tension shaft
25	20021	6-40 x 1/4" Flat-head screw
26	76276	Tension-shaft clamp
28	43040	#6 Lockwasher
29		Balancing motor assembly
	96871	0.4- second pen-speed motor (120 volt, 50-60 cycle)
	96873	1-second pen-speed motor and gear train complete
	96871	1000 rpm motor (120 volt, 50-60 cycle)
	97638	Gear complete (72T-64P)
	B1878	1-second pen speed worm gear drive complete
	C1598	Motor only
	A4567	Worm gear
	A4564	Clutch assembly
	96848	3-second pen-speed motor and gear train complete
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96868	Gear complete (88T-64P)
	96849	4.5-second pen-speed motor with pinion (120 volt, 60 cycle)
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96859	Gear complete (140T-64P)
	93699	7-second pen-speed motor (120 volt, 25 cycle)
	B1424	12-second pen-speed motor complete
	96872	1000 rpm motor
	97647	Gear complete (120T-48P)
	A3425	Pinion and gear
	96874	24-second pen-speed motor and gear train complete
	96872	1000 rpm motor (120 volt, 60 cycle)
	97652	Gear complete (88T-64P, 15T-48P)
	97647	Gear complete (120T-48P)
30		Motor pinion
	91930	for instruments with 24-second pen travel
	91930	for instruments with 12-second pen travel
	86036	for instruments with 7-second or 4.5-second pen travel
	91932	for instruments with 3-second pen travel
	A4988	for instruments with 0.4-second pen travel
	86029	Terminal block
	86031	Marking strip
	45081	Spacers
	41519	Screws
	86030	Cover
	10075	Washer
	43040	Washer

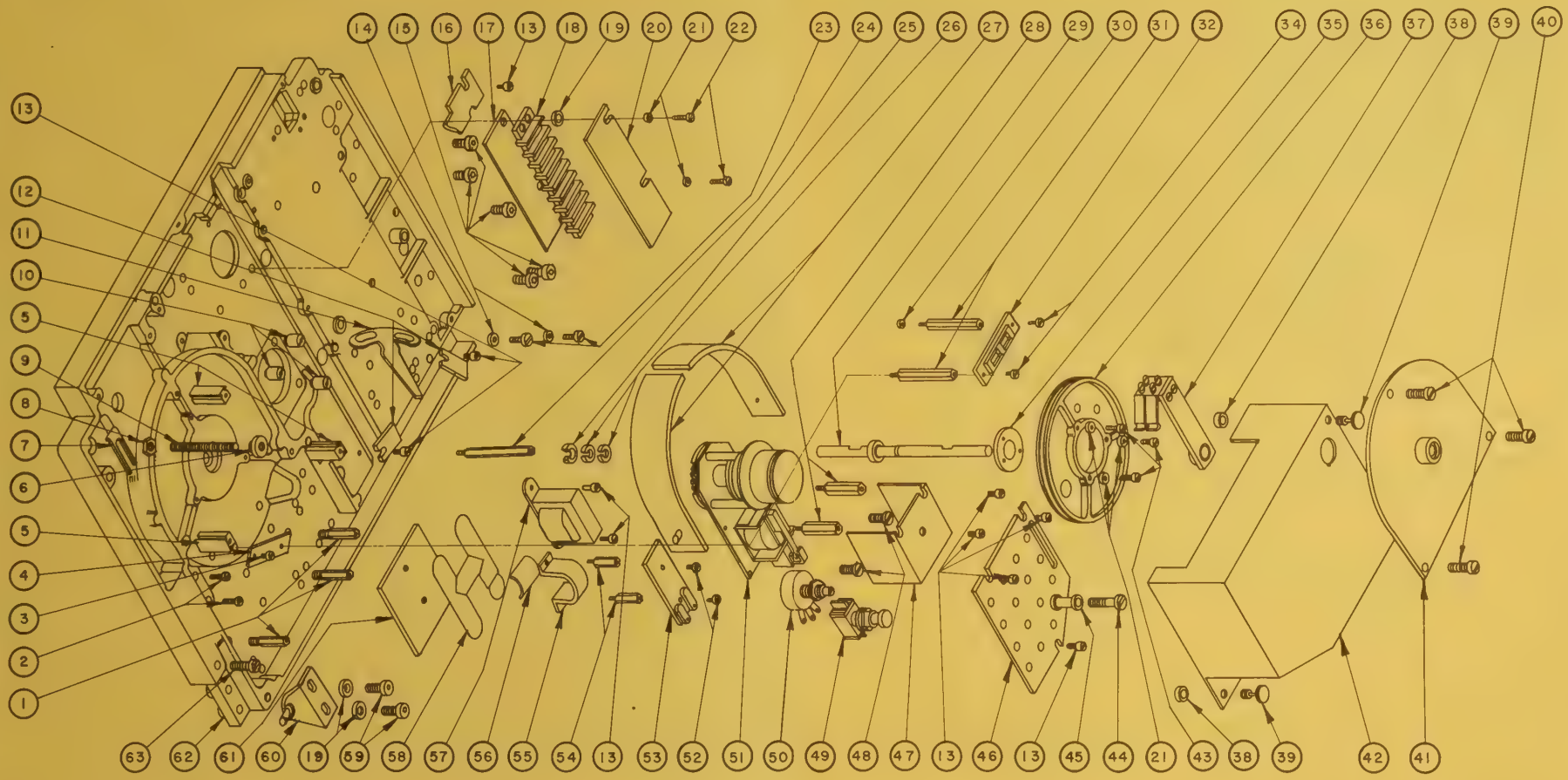

FIGURE 4. REAR OF HINGED PANEL

ITEM	PART NO.	DESCRIPTION
1	88141	Posts - for instrument with 1-standard cell
	93664	Posts - for instrument with 2-standard cell
2	66541	10-32 x 1/2" Fillister-head screw
3	91089	6-40 x 1/4" Special-head screw
4	89118	Clamp
5	89112	Post for slidewire cover
6	79209	Change-gear locknut
7	86083	Cable clamp
8	68556	10-32 Hexagon nut
9	73855	10-32 x 2 1/4" Change-gear stud
10	86053	Motor mounting nuts
11	85272	Gear stop for instruments with 3-, 4.5-, 7-, and 24- second pen travel
	93320	Gear stop for instruments with 0.4- and 1-second pen travel
12	85273	Cable clamp
13	39770	6-40 x 1/4" Fillister-head screw
14	10075	Washer
15	89660	1/4"-20 x 1/2" Hexagon-socket cap screw (door hinge)
16	91678	Cable cover
17	95614	8-point terminal block cover
18	95611	8-point terminal block
19	45081	Spacer
20	95612	Marking strip (L_2, C_2, L_1, M_1, M_2, C_1, L_1, L_2)
21	43040	#6 Lockwasher
22	41519	6-40 x 3/4" Fillister-head screw
23	66539	10-32 x 3/8" Fillister-head screw
24	86014	Post for calibration-spool cover
25	A5078	Thrust washer
26	89117	Retaining ring
27	89865	Cover for slidewire (all but 0.4 second instruments.)
	A3805	Cover for slidewire (used on 0.4 second instruments.)
28	93C26	Post
29	93C34	Balancing-mechanism shaft (560)
	96809	Balancing-mechanism shaft (570)
	A4010	Balancing-mechanism shaft (570-microact)
		Control-double front set (GID2)
	A5080	Bearing
30	95425	Washer
31	95424	Post
32		Slidewire trimmer, give model and serial no. of instrument
34	51556	4-48 x 5/16" Fillister-head screw
35	A5079	Cover plate for bearing
36		Slidewire complete (give model and serial number of instrument)
37	95639	Contact arm for AC-DC instruments
	B1464	Contact arm only for above
	A4001	Contact arm complete for KARMA slidewires only AC-DC
	B1551	Contact arm only for part A4001
38	82381	Washer
39	55785	10-32 Special-thumb screw
40	36344	6-40 x 7/8" Fillister-head screw
41	89104	Cover for slidewire
42		Cover for calibration spools
	89113	1-pen multiple-point AC-DC instruments
	93607	2-pen instruments
43	35882	6-40 x 1/2" Fillister-head screw for d-c instruments
	36344	6-40 x 7/8" Fillister-head screw for a-c instruments
44	91046	6 x 1 1/8" Aluminum round-head self-tapping screw
45		Calibration spools (order by model and serial number of instruments, giving information on label of spool)
46	A5779	Mounting plate for calibration spools
47	85284	Standardizing relay cover
48	34976	6-40 x 9/16" Fillister-head screw
49	93098	Push-button switch for constant voltage source
50	92900	Rheostat for constant voltage source
51		Standardizing unit complete (specify model and serial number of instrument)
	A5898	Upper friction disk
	A5993	Lower friction disk
52	91089	6-40 x 1/4" Special-head screw (for 1-cell)
	20021	6-40 x 1/4" Flat-head screw (for 2-cell)
53	87502	Terminal plate (for 1-cell)
	93660	Terminal plate (for 2-cell)
54	77020	Post
55	62645	Clamp (for 1-cell or top cell of 2-cell instrument)
	93663	Clamp (for bottom cell of 2-cell instrument)
56	62646	Felt pad (for 1-cell or top cell of 2-cell instrument)
	93662	Felt pad (for bottom cell of 2-cell instrument)
57	84245	Transformer (50-60 cycle) } st'd a-c bridges
	72557	Transformer (25 cycle) }
	98090	Transformer (50-60 cycle) } as req'd for strain gauges
	A3830	Transformer (25-cycle) }
	91029	Transformer (50-60 cycle) } as req'd for conductivity
	76324	Transformer (25-cycle) }
58	62327	Standard cell
59	38811	Washer
60	85296	Latch pin
61	85791	Standard cell mounting pad
62	98350	Mounting frame for 1-pen and multiple point instruments
	B1151	Mounting frame for 2-pen instrument
63	47042	10-32 x 1 1/8" Fillister-head screw

ITEM	PART NO.	DESCRIPTION
		Chart drive complete, without motor
	79220	with aluminum roll
	82424	with rubber covered roll
	D1008	Swing out chart drive (for two-pen recorder)
1	72403	Retaining ring
2	35638	#10 Lockwasher
3	67029	10-32 x 5/16" Fillister-head screw
4	79208	Loading-spindle adjusting nut
	*82404	6-40 x 3/16" Bristo flat-point setscrew for item 4
5	88885	Collar, not including setscrew
	*82404	6-40 x 3/16" Bristo flat-point setscrew for item 5
6	39425	10-32 x 1/4" Special-head screw
7	79290	Bearing screw
8	66539	10-32 x 3/8" Fillister-head screw
9	79203	Foot for 1-pen and multiple-point instruments
	A2078	Foot for 2-pen instruments
10	79291	Bearing
11	11386	Hexagon nut
12	79288	End plate (left hand) for 1-pen and multiple-point instruments
	A1530	End plate (left hand) for 2-speed chart drives
	A2068	End plate (left hand) for swing-out chart drive
13	79243	Shaft and hub complete
14	79236	Clutch facing
15	79241	Gear (80T-48P)
16	79237	Washer
17	79240	Spring
18	79235	Washer
19	79296	Chart-guide support rod (note: substitute item 43 for 2-pen instruments)
20	79295	Chart guide
	*30628	4-48 x 3/16" Fillister-head screw
21	94587	Spacer for chart cut-off plate
22	94030	Chart feed roll (aluminum)
	94031	Chart feed roll (rubber covered)
23	73927	2-64 x 7/32" Fillister-head screw
24	79231	Sprocket (26 tooth) not including setscrew
	*82414	10-32 x 1/4" Bristo flat-point setscrew
25	83895	Bearing nut
26	83849	Sprocket (16 tooth)
27	21252	Washer
28	31427	6-40 x 5/16" Fillister-head screw
29	84743	Knob
	*82415	10-32 x 1/4" Bristo cup-point setscrew
30	43040	#6 Lockwasher
31	79289	End plate (right hand) for 1-pen and multiple-point instrument
	A2070	End plate (right hand for 2-pen instruments)
	*85216	Spring post — order assembled to end plate A2070
	*A2071	Latch lever — order assembled to end plate A2070
	*43184	Shim — order assembled to end plate A2070
	*A2074	Stud — order assembled to end plate A2070
	*85217	Stud — order assembled to end plate A2070
	*52618	Washer — order assembled to end plate A2070
	*42098	10-32 x 7/16" Fillister-head screw — order assembled to end plate A2070
	*85214	Latch spring for swing-out chart drive for 2-pen instruments
32	18339	6-40 x 3/16" Fillister-head screw
33	79205	Latch spring
	A2075	Latch spring for 2-pen instruments
34	79250	Rewind knob, not including setscrew
	*	10-32 x 1/8" Bristo flat-point setscrew
35	79247	Thrust washer
36	95498	Rewind shaft
37	79257	Thrust washer
38	79253	Spring
39	79252	Sprocket (16 tooth) and hub
40	79248	Clutch facing
41	79256	Loading spindle
42	82380	Spring housing
43	79282	Brace rod
44	79238	Spring
45	79200	Spring-tension nut
46	79228	Chain

*Not Shown

(continued on page 9)

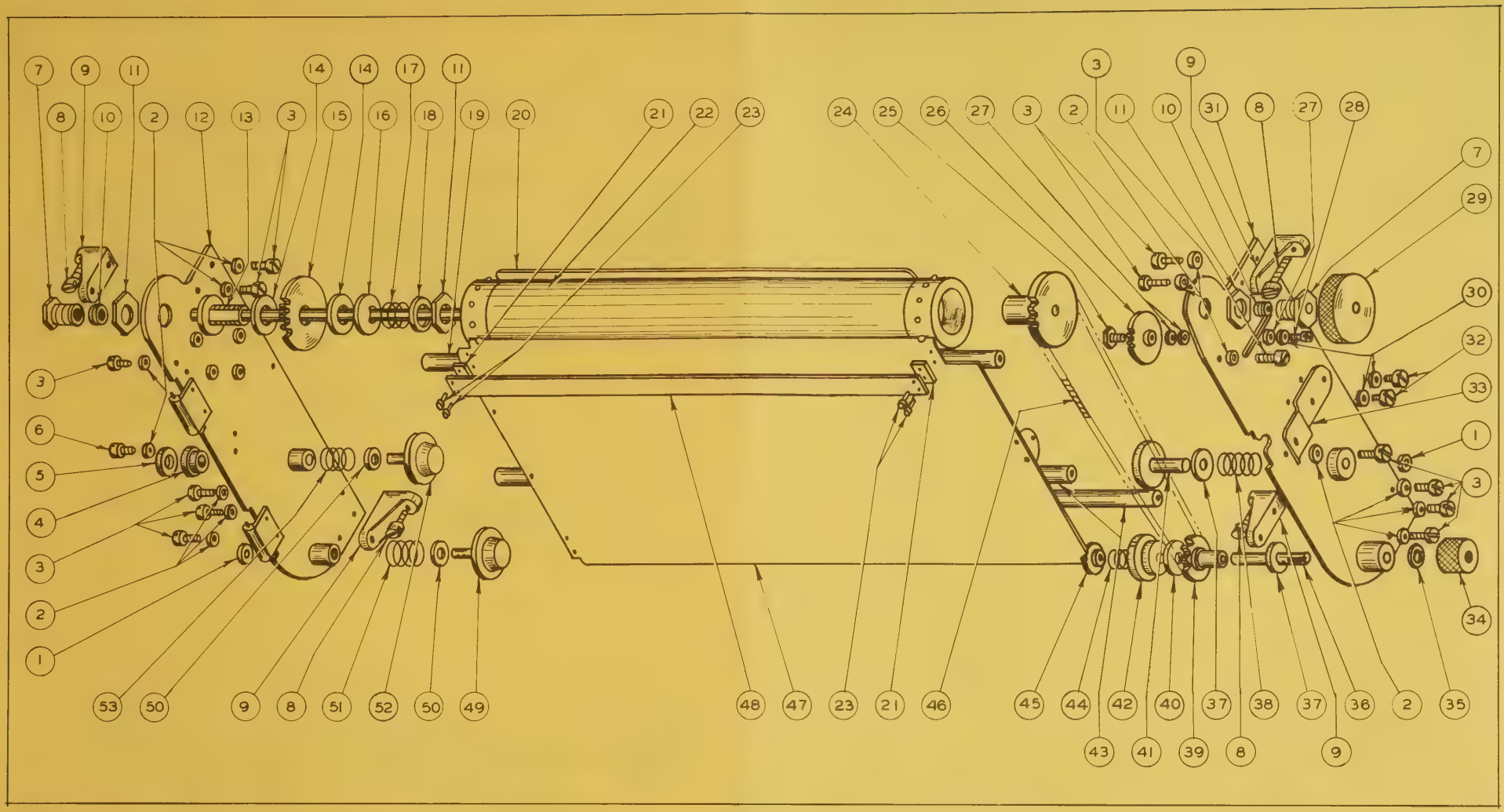

FIGURE 5. CHART-DRIVE MECHANISM WITHOUT MOTOR

ITEM	PART NO.	DESCRIPTION
47	79284	Chart plate (note: when used with chart cut-off guide, order drilled per sheet 94426)
48	94586	Chart cut-off guide
49	79263	Rewind spindle
50	79265	Spring collar
51	79264	Spring
52	A5077	Loading spindle
53	79232	Spring
	*63891	Chart rewind tube (cardboard)
	*86021	Chart clip

NOT SHOWN PARTS FOR SWING OUT CHART DRIVE FOR 2-PEN INSTRUMENTS

B1155	Hinge
66562	10-32 x 3/8" Flat-head screw for mounting hinge, part #B1155
66539	10-32 x 3/4" Fillister-head screw for mounting hinge part #B1155
A2079	Hinge pin
B2414	10/32 x 1/4" Bristo flat-point setscrew
B1502	Tie bar (Lower)
B1503	Tie bar (Upper)
96866	10-32 Shoulder screw
86324	10-32 x 1/2" Bristo hexagon-socket cap screw

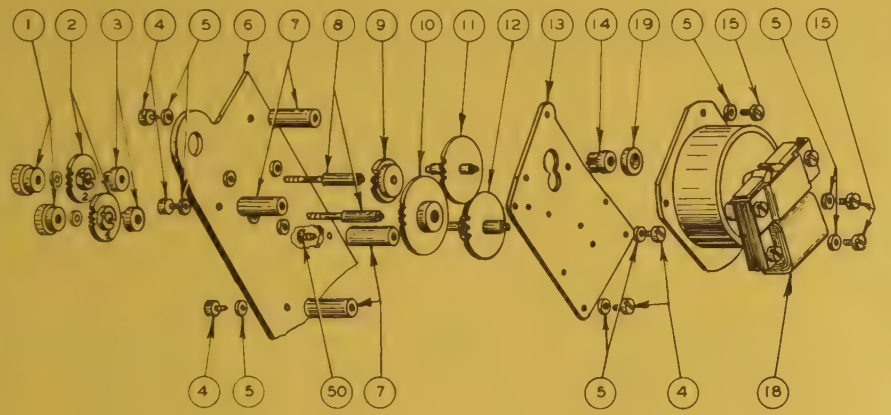

FIGURE 6. LOW-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 2- OR 4-RPM TELECHRON MOTOR

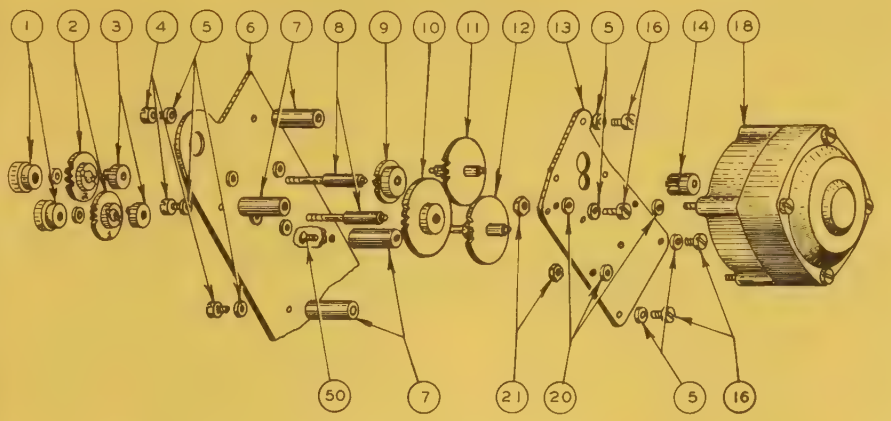

FIGURE 7. LOW-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 10- OR 60-RPM HOLTZER-CABOT MOTOR

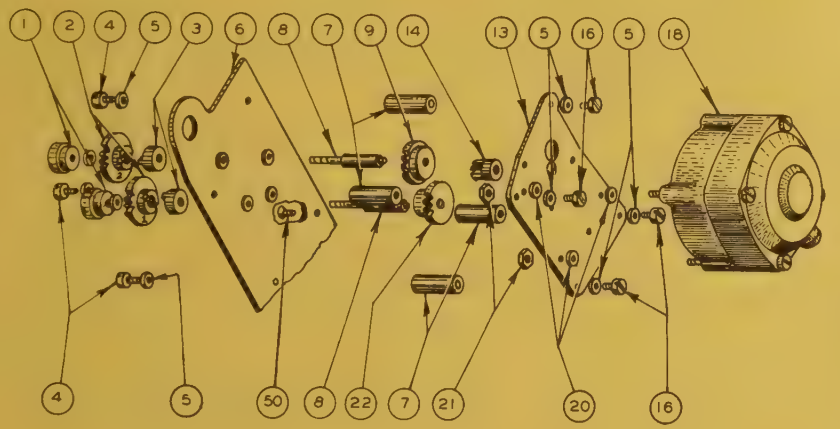

FIGURE 8. HIGH-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 4-, 10- OR 60-RPM HOLTZER-CABOT MOTOR

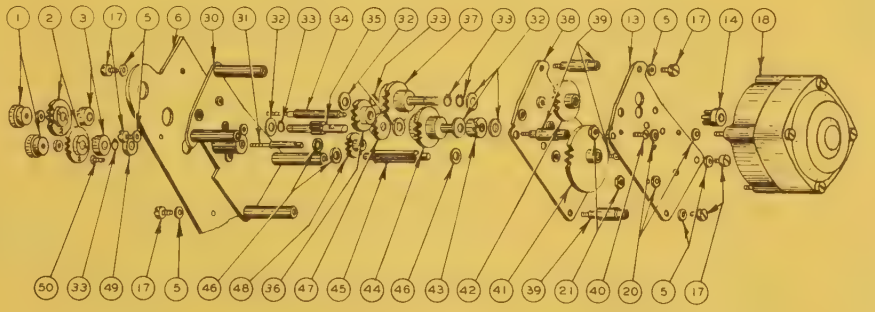

FIGURE 9. TWO-SPEED CHART-DRIVE MOTOR

ITEM	PART NO.	DESCRIPTION
1	79209	Knurled nut
	35638	Lock washer
2		Change gears (see table figure 21)
3	79210	Change-gear collar, not including setscrew
	*82403	6-40 x 1/8" Bristo flat-point setscrew for item 3
4	31427	6-40 x 5/16" Fillister-head screw
5	43040	#6 Lockwasher
6		Left-hand chart-drive plate (see figure 5 item 12)
7	76281	Post
8	79270	Change-gear shaft
9	79266	Gear (40T-48P)
	82403	6-40 x 1/8" Bristo flat-point setscrew
10	79269	Third gear (75T-48P)
	82413	10-32 x 3/16" Bristo flat-point setscrew
11	79277	First gear (15T x 63T-48P)
12	79274	Second gear (16T x 64T-48P)
13	79279	Mounting plate for single-speed, chart-drive motor
	A1531	Mounting plate for two-speed, chart-drive motor
14	53086	Motor Pinion (14T-48P) (not including setscrew) for low-speed chart drive
	51590	Motor pinion (16T-48P) (not including setscrew) for high-speed chart drive
	A1532	Motor pinion (16T-48P) (not including setscrew) for 2-speed chart drive
	82403	6-40 x 1/8" Bristo flat-point setscrew for above
	55269	Washer used with 2-speed chart drive
	28543	Washer used with 2-speed chart drive
15	18329	6-40 x 3/8" Fillister-head screw
16	39770	6-40 x 1/4" Fillister-head screw
17	66372	6-40 Shoulder screw
18	86058	Chart-drive motor, Telechron type C5 (120 volt, 60 cycle, 2 rpm)
	86059	Chart-drive motor, Telechron type C5 (120 volt, 50 cycle, 2 rpm)
	86060	Chart-drive motor, Telechron type C5 (120 volt, 25 cycle, 2 rpm)
	92110	Chart-drive motor, Telechron type C5 (120 volt, 60 cycle, 4 rpm)
	92111	Chart-drive motor, Telechron type C5 (120 volt, 50 cycle, 4 rpm)
	93963	Chart-drive motor, Telechron type C5 (120 volt, 25 cycle, 4 rpm)
	96738	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 4 rpm)
	B2274	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 50 cycle, 4 rpm)
	88060	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 10 rpm)
	B2275	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 50 cycle, 10 rpm)
	53680	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 60 rpm)
	54603	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 50 cycle, 60 rpm)
	92128	Chart-drive motor, Holtzer-Cabot type RWC2510 (120 volt, 60 cycle, 60 rpm)
	B1277	Chart-drive motor, Holtzer-Cabot type RBC2505 (120V, 60 Cy. 1 RPM)
	B1276	Chart-drive motor, Holtzer-Cabot type RBC2505 (120V, 60 Cy. 2 RPM)
	B1279	Chart-drive motor, Holtzer-Cabot type RBC2510 (120V, 60 Cy. 60 RPM)
19	79278	Locating ring
20	2420	Washer
21	94855	8-32 Hex. nut
22	91935	Gear (36T-48P) not including setscrew
	*82413	10-32 x 3/16" Bristo flat-point setscrew
30	B1095	Left-hand plate complete
31	A1508	Change-gear shaft
32	10075	Thrust washer
33	79854	Retaining ring
34	A1505	Change-gear shaft
35	A1509	Pinion shaft (16T-48P)
36	A1552	Gear complete (40T-48P) including setscrew
	82413	10-32 x 3/16" Bristo flat-point setscrew
37	A1512	Shaft and clutch complete
38	A1523	Right-hand plate
39	A1525	Post
40	37751	6-40 x 5/8" Flat-head screw
41	A1528	Gear complete (80T-48P) including setscrew
	82404	6-40 x 3/16" Bristo flat-point setscrew
42	A1526	Gear complete (48T-48P) including setscrew
	82404	6-40 x 3/16" Bristo flat-point setscrew
43	A1550	Gear complete (40T-48P) for 10-1 ratio, including setscrew
	85855	6-40 x 1/4" Bristo flat-point setscrew
	A1547	Gear complete (12T-48P) for 30-1 ratio, not including setscrew
	*82404	6-40 x 3/16" Bristo flat-point setscrew for part number A1547
	A1520	Gear complete (15T-48P) for 60-1 ratio including setscrew
	82403	6-40 x 1/8" Bristo flat-point setscrew
44	A1518	Shaft and clutch complete
45	A1522	Pinion shaft (12T-48P)
46	86048	Thrust washer
47	A1548	Gear complete (20T-49P) for 10-1 ratio, including setscrew
	82403	6-40 x 1/8" Bristo flat-point setscrew
	A1507	Gear complete (36T-48P) for 30-1 ratio including setscrew
	82413	10-32 x 3/16" Bristo flat-point setscrew
	A1510	Gear complete (45T-48P) for 60-1 ratio including setscrew
	82404	6-40 x 3/16" Bristo flat-point setscrew
48	A1507	Gear complete (36T-48P) including setscrew
	82413	10-32 x 3/16" Bristo flat-point setscrew
49	13256	Collar
50	20335	6-40 x 5/16" Flat-head screw

*Not Shown

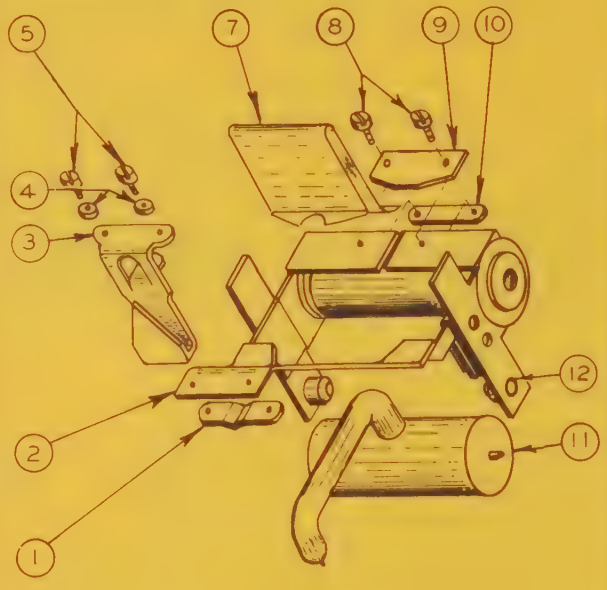

FIGURE 10. PEN ASSEMBLY FOR A STANDARD 1-PEN RECORDER

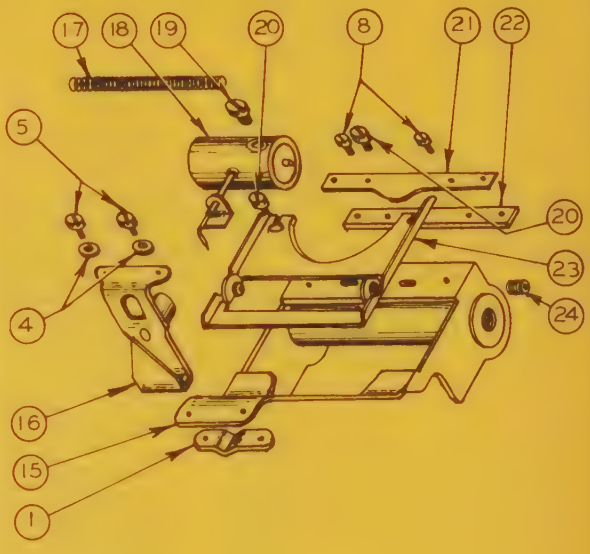

FIGURE 11. PEN ASSEMBLY FOR A 0.4 SEC. RECORDER

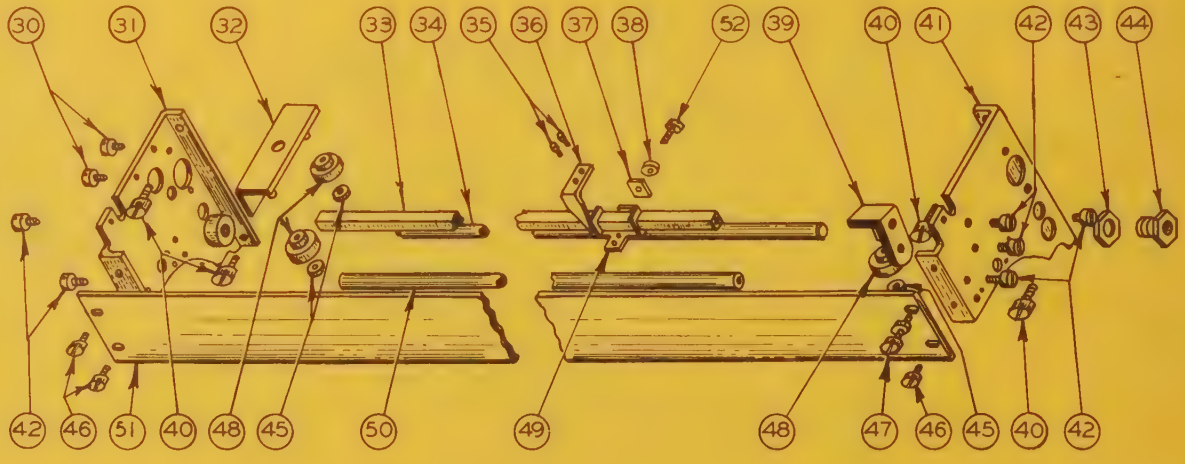

FIGURE 12. PEN-ASSEMBLY SUPPORT FOR A 1-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	85230	Indicator clamp
2	93348	Pen-carriage assembly complete, less pen
3	85224	Indicator
4	37267	Washer
5	65071	3-56 x 1/8" Fillister-head screw
7	93358	Spring clip
8	30628	4-48 x 3/16" Fillister-head screw
9	85228	Cord clamp
10	85229	Strap
11	85206	Standard Pen (Glass)
	95377	Metal pen
12	A4595	Pivot screw
15	A2212	Pen-carriage assembly complete, less pen (for 0.4-second pen speed)
16	A2213	Indicator (for 0.4-second pen speed)
17	39890	Tension spring
18	A2200	Pen for 0.4-second pen speed (includes item 19)
19	A2211	Filler cap (included in item 18)
20	A2218	Thumb screw
21	A2222	Cord clamp
22	A2223	Strap
23	B1212	Pen mounting (includes item 24)
24	A2221	6-32 Pivot screw (included in item 23)
30	18339	6-40 x 3/16" Fillister-head screw
31	85298	Left-hand support bracket (standard)
	A2227	Left-hand support bracket complete (0.4-second pen speed)
	A2228	Left-hand support bracket only (0.4-second pen speed)
	A2225	Pen-stop bracket
	A1568	Pen-stop adjusting screw
	68556	10-32 Jam nut for adjusting screw
	47622	Washer for adjusting screw
	A1567	Bumper, on end of adjusting screw
	66537	10-32 x 1/4" Fillister-head screw, to mount bracket A2225
	35638	#10 Lockwasher for above screw.
32	88185	Control-Index-pulley bracket complete (includes items 45 and 48)
33	88188	Control-Index support rod
34	85271	Pen-support rod
35	93976	2-64 x 3/32" Fillister-head screw
36	88189	Control index
37	88191	Indicator-cord clamp
38	76293	2-64 Thumb nut
39	88181	Control-index-pulley bracket complete, (includes items 45 and 48)
40	66539	10-32 x 3/8" Fillister-head screw
41	85249	Right-hand support bracket (standard)
	A2224	Right-hand support bracket complete (0.4 second pen-speed)
	A2226	Right-hand support bracket only (0.4-second pen speed) for breakdown of pen-stop parts, see item 31 Part #A2227
42	39770	6-40 x 1/4" Fillister-head screw
43	85269	7/16"-27 Hex nut
44	85268	Bearing screw
45	79854	Retaining ring (3/8" shaft)
46	91089	6-40 x 1/4" Special-head screw
47	61682	6-40 Double-head screw
48	76283	Cord pulley
49	88190	Pointer bracket
	40018	2-64 x 1/4" Fillister-head screw
50	85256	Pen-carriage guide rod
51		Scale (order by model and serial number of instrument)
52	40018	2-64 x 1/4" Fillister-head screw

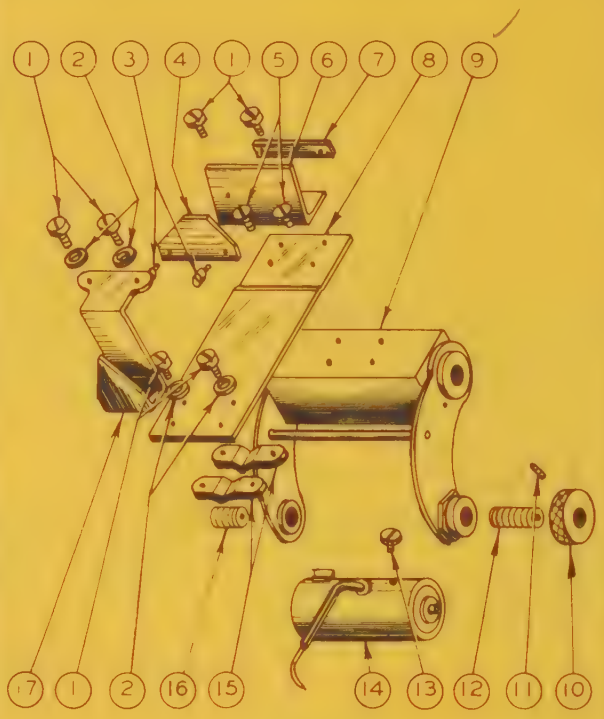

FIGURE 13. UPPER (NO. 2) PEN ASSEMBLY FOR 2-PEN RECORDER

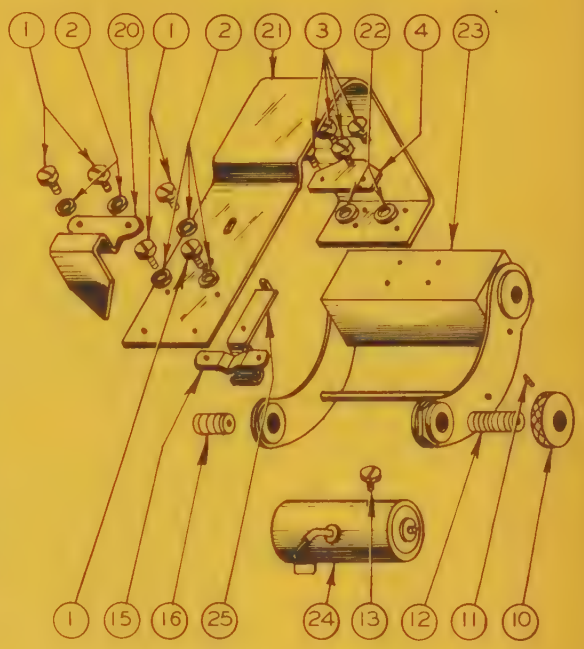

FIGURE 14. LOWER (NO. 1) PEN ASSEMBLY FOR 2-PEN RECORDER

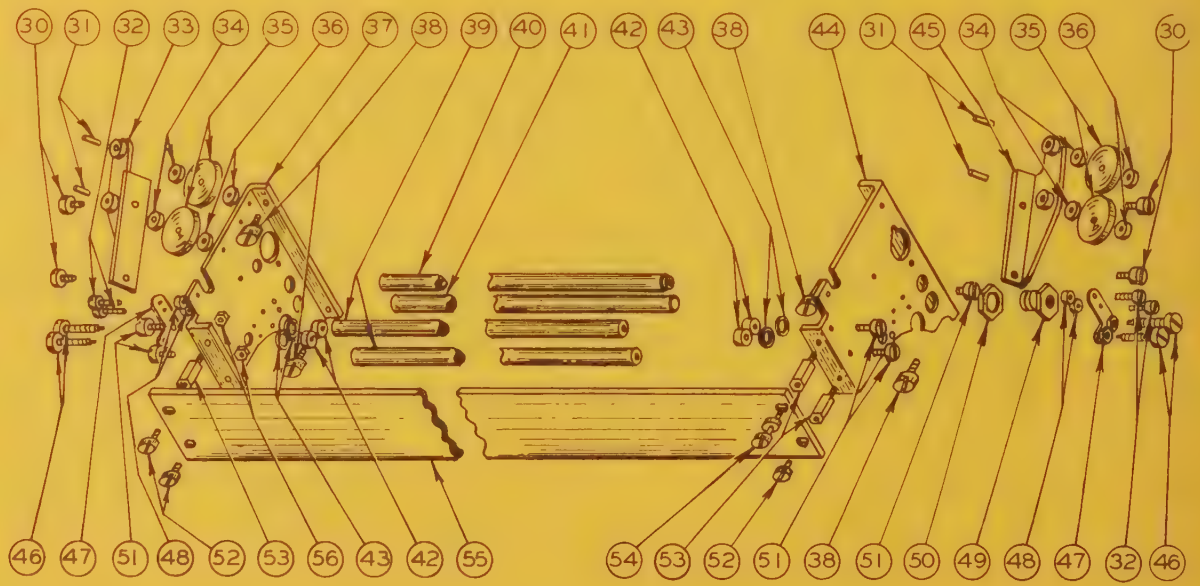

FIGURE 15. PEN ASSEMBLY SUPPORT FOR 2-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	65071	3-56 x 1/8" Fillister-head screw
2	72103	Washer
3	61247	4-48 x 1/4" Fillister-head screw
4	85228	Cord clamp
5	20860	4-48 x 1/4" Flat-head screw
6	93399	Cord-clamp bracket
7	85229	Strap
8	A2090	Indicator bracket (#2 pen)
9	B1159	#2 Pen carriage (includes items 10, 11, 12 and 16)
10	A2083	6-32 Thumb nut
11		6-40 x 1/8" Bristo cone-point setscrew
12	A2087	6-32 x 1/2" Pivot screw
13	A2101	Filler cap
14	B1162	#2 Pen (includes item 13)(used on models 2P6H560, 2P7H560 etc)
	94299	#2 Pen (used on Models 2P2H560, 2P3H560 etc.)
15	85230	Indicator clamp
16	A2084	6-32 x 3/8" Pivot screw
17	95872	Indicator (#2 pen, blue)
20	95871	Indicator (#1 pen, red)
21	A2080	Indicator bracket (#1 pen)
22	45692	Washer
23	B1158	#1 Pen carriage (includes items 10, 11, 12 and 16)
24	B1161	#1 Pen (includes item 13)(used on models 2P6H560, 2P7H560 etc)
	94298	#1 Pen (used on Models 2P2H560, 2P3H560, etc.)
25	93390	Indicator guide
30	18339	6-40 x 3/16" Fillister-head screw
31	85291	Pulley shaft for 3-, 7-, 12- and 24-second pen speeds
	A2206	Pulley shaft for 1-second pen speed
32	64029	8-32 x 7/16" Fillister-head screw
33	92392	Cord-pulley bracket complete, left hand, for 3-, 7-, 12- and 24-second pen speeds (including items 31, 34, 35 and 36)
	98007	Pulley bracket only
	*82403	6-40 x 1/8" Bristo flat-point setscrew
	A3814	Cord-pulley bracket complete, left hand for 1-second pen speed (including items 31, 34 and 35)
	98007	Pulley bracket only
	*82403	6-40 x 1/8" Bristo flat-point setscrew
34	29211	Spacer
35	92390	Pulley for 3-, 7-, 12- and 24-second pen speeds
	A3811	Pulley for 1-second pen speed
36	79854	Retaining ring
37	B1157	Left-hand support bracket
38	66539	10-32 x 3/8" Fillister-head screw
39	85256	Pen guide rod
40	93380	Pen support rod #2 pen
41	85271	Pen support rod #1 pen
42	A1567	Bumper
43	47622	Washer
44	B1156	Right-hand support bracket
45	92387	Cord-pulley bracket complete, right hand, for 24- 12- 7- and 3-second pen speeds (including items 31, 34, 35 and 36)
	98006	Pulley bracket only
	*82403	6-40 x 1/8" Bristo flat-point setscrew
	A3813	Cord-pulley bracket complete, right hand for 1-second pen speed (including items 31, 34 and 35)
	98006	Pulley bracket only
	*82403	6-40 x 1/8" Bristo flat-point setscrew
46	A1568	Adjusting screw
47	A2067	Bumper bracket
48	76302	Spacer
49	85268	Bearing
50	85269	Locknut
51	39770	6-40 x 1/4" Fillister-head screw
52	91089	6-40 x 1/4" Special-head screw
53	93392	Post
54	61682	Double-headed screw
55		Scale (order by model and serial number of instrument)
56	20903	6-40 Hexagon nut

*Not Shown

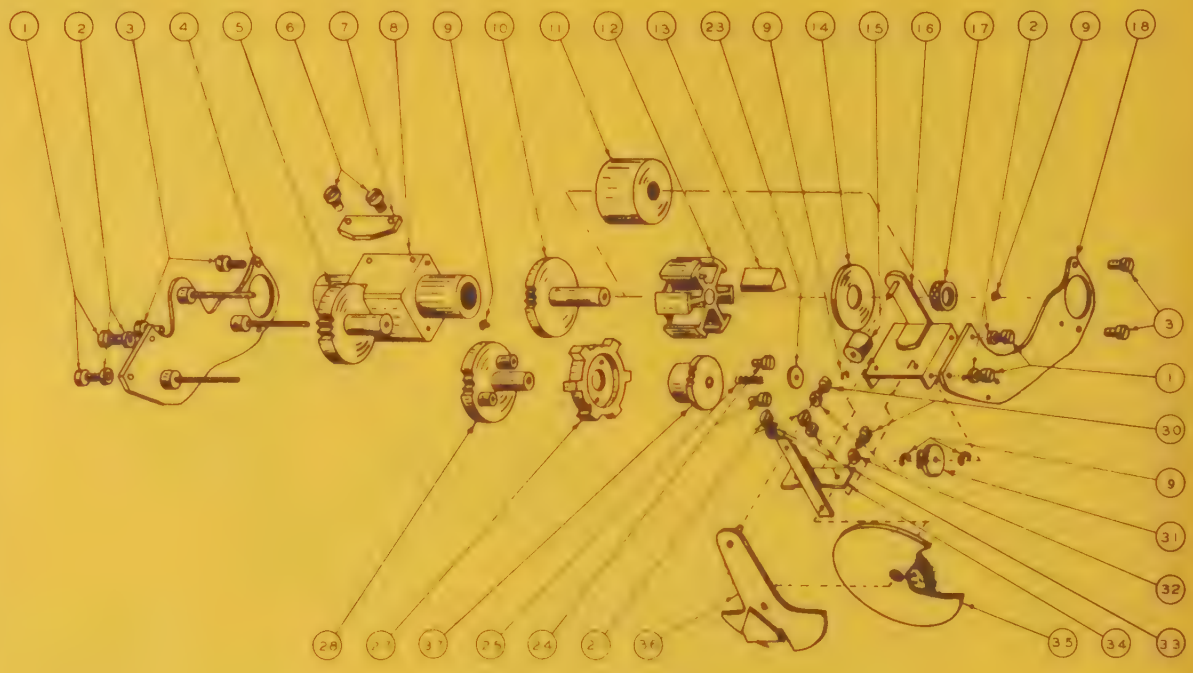

FIGURE 16. MULTIPLE-PRINTING MECHANISM

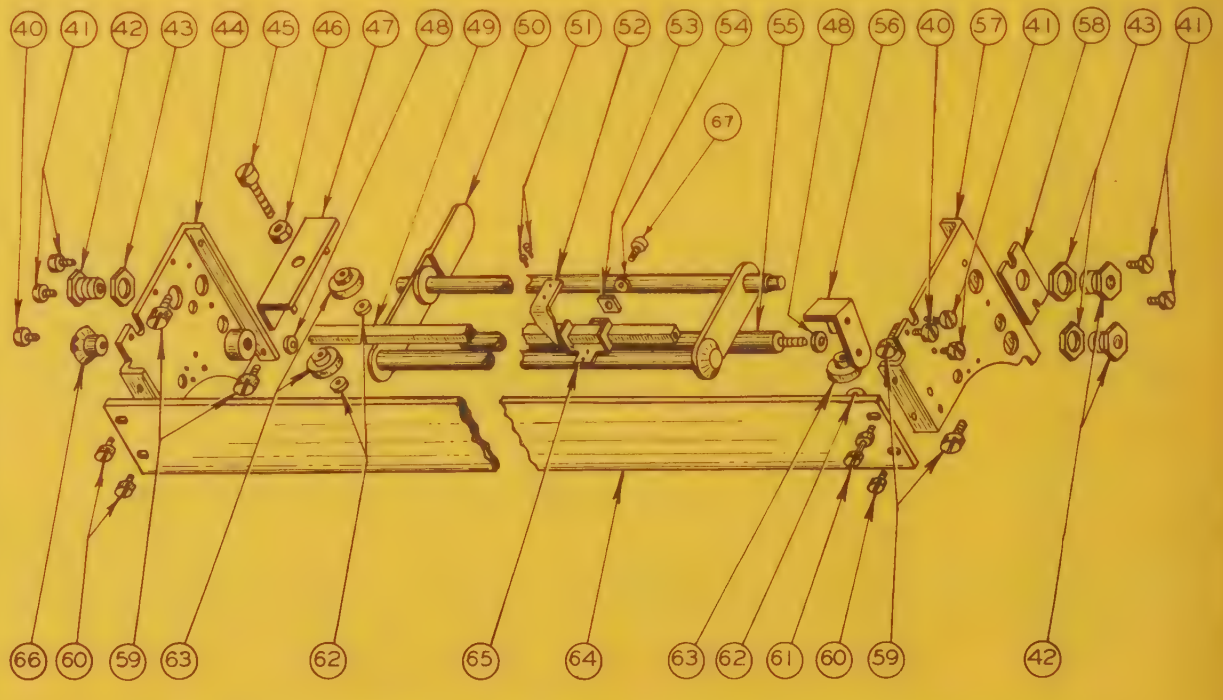

FIGURE 17. PRINTING MECHANISM SUPPORT FOR MULTIPLE-POINT RECORDER

ITEM	PART NO.	DESCRIPTION
1	37603	2-64 x 3/16" Fillister-head screw
2	68791	#2 Lockwasher
3	10626	4-48 x 1/8" Fillister-head screw
4	85263	Left-hand plate
5	86072	Gear (48T-48P)
6	30628	4-48 x 3/16" Fillister-head screw
7	85228	Cord clamp
8	85235	Frame
9	80607	Retaining ring (1/8" shaft)
10	88197	Gear (48T-48P)
11	89897	Ink roll complete for 1-color printing (purple)
	94449	Container of 5-rolls of item 11
12	68196	Felt-holder (6-segment)
	69626	Felt-holder (8-segment)
	94272	Felt-holder (12-segment) (Separate cap - part 94274)
13		INKING FELTS (CONTAINER OF 6)

	BLACK	RED	PURPLE	GREEN	BLUE	BROWN
6-segment	91000	91001	91002	91003	91004	91005
8-segment	91006	91007	91008	91009		
12-segment	94282	94283	94284	94400	94401	94402

14 DESIGNATION DISK

69545 - 2-point		69645 - 4-point	
68199 - 3-point		68198 - 6-point	

ITEM	PART NO.	DESCRIPTION
15	86070	Roller Complete
16	85293	Roller bracket complete
17	68182	Thumb nut
18	96762	Right-hand plate
21	65071	3-56 x 1/8" Fillister-head screw
23	23212	Washer
24	73927	2-64 x 7/32" Fillister-head screw
25	86066	Spring
27	87374	Type wheel (dots only) 2, 3, or 6-point
	87375	Type wheel (dots only) 4-point

TYPE WHEEL (DOTS AND NUMBERS)

68193 - 2-point	68195 - 6-point	87841 - 12-point	96118 - 24-point
68194 - 3-point	69636 - 8-point	89872 - 16-point	
69637 - 4-point	94433 - 10-point	94440 - 20-point	

ITEM	PART NO.	DESCRIPTION
28	86073	Gear and hub (48P-48T)
30	63800	1-72 Fillister-head screw
31	96760	Idler gear
32	42762	Washer
33	96752	Washer
	70694	Shakeproof washer
34	96758	Mounting bracket
35		Indexing disc

96798 - 2-point	96788 - 6-point	96779 - 12-point	96770 - 24-point
96794 - 3-point	96785 - 8-point	96776 - 16-point	
96791 - 4-point	96782 - 10-point	96773 - 20-point	

ITEM	PART NO.	DESCRIPTION
36	96768	Shield and pointer
37	96753	Idler drive gear
	82403	6-40 x 1/8" flat-point setscrew
40	39770	6-40 x 1/4" Fillister-head screw
41	18339	6-40 x 3/16" Fillister-head screw
42	85268	Bearing screw
43	85269	7/16"-27 Hexagon nut
44	85298	Left-hand support bracket
45	66546	10-32 x 1" Fillister-head screw
46	72055	10-32 Hexagon nut
47	88185	Control-index pulley complete (including items 62 & 63)
48	86048	Thrust washer
49	88188	Control-index support rod
50	86088	Depressor bar
51	62795	2-64 x 3/32" Hexagon-head screw
52	88189	Control index
53	88191	Cord clamp
54	76293	2-64 Thumb nut
55	86078	Spline shaft
56	88181	Control-index pulley complete (includes items 62 and 63)
57	85249	Right-hand support bracket
58	86091	Adjusting plate
59	66539	10-32 x 3/8" Fillister-head screw
60	91089	6-40 x 1/4" Special-head screw
61	61682	6-40 Double-headed screw
62	79854	Retaining ring (3/16" shaft)
63	76283	Pulley
64		Scale (order by model and serial number of instrument)
65	88190	Control-index bracket
66	44009	Miter gear
67	40018	2-64 x 1/4" Fillister-head screw

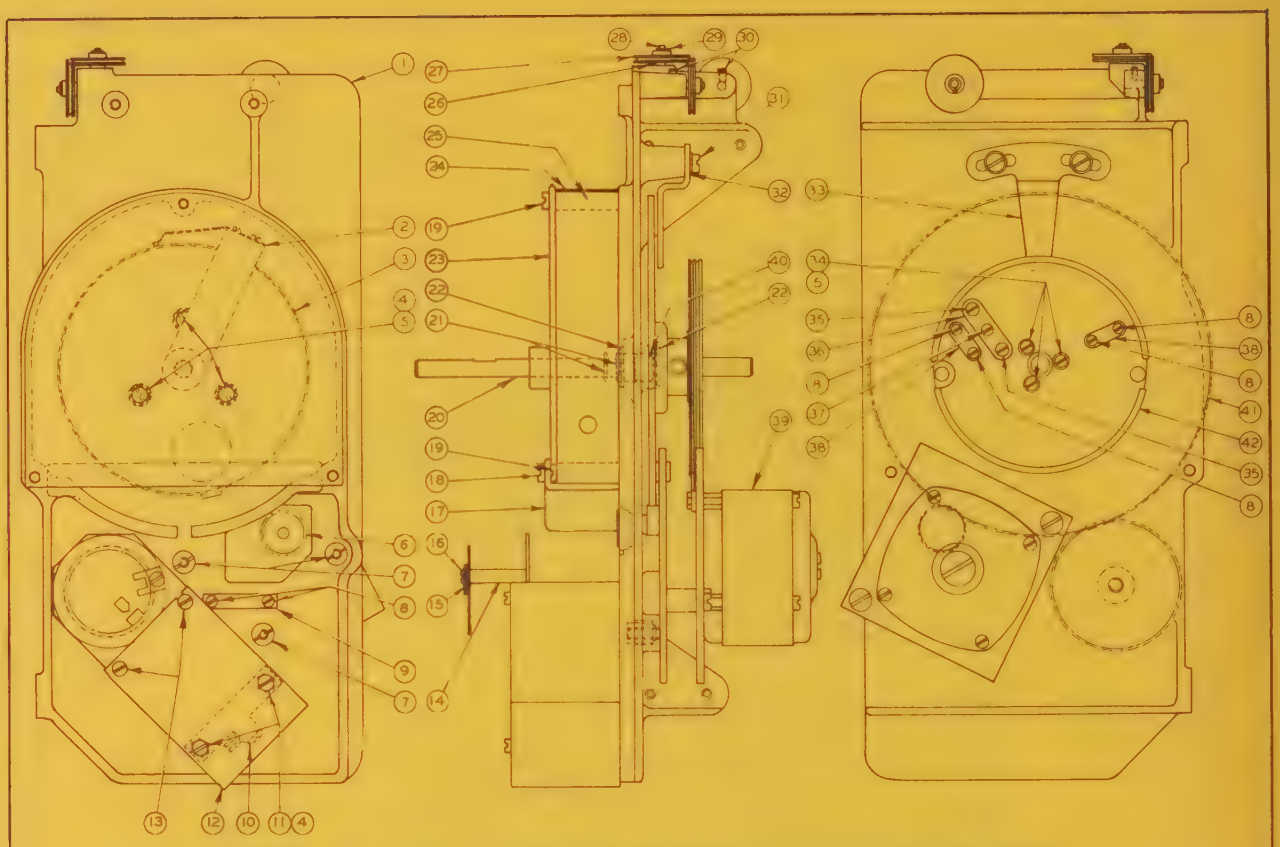

FIGURE 18. NO. 2 BALANCING MECHANISM FOR 2-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	D1007	Frame
2	95638	Brush arm complete for a-c instruments
	95639	Brush arm complete for d-c instruments
	11394	3-56 x 1/4" Flat-head screw
	18371	3-56 x 3/16" Fillister-head screw
	89100	Support arm complete
	B1664	Contact arm
	95647	3-56 Shoulder screw
	95624	Mounting block
	95637	Clamping strap
	*82413	10-32 x 3/16" Bristo flat-point setscrew for item 2
3		Slidewire (order by model and serial number of instrument)
4	19536	6-40 x 5/8" Fillister-head screw
5	43040	#6 Lockwasher
6		Motor pinion
	91930	For instruments with 24-second pen travel
	86036	For instruments with 7-second or 4.5-second pen travel
	91932	For instruments with 3-second or 1-second pen travel
	A2246	For instruments with 0.4-second pen travel
7	86053	Motor-mounting nuts
8	39770	6-40 x 1/4" Fillister-head screw
9	89118	Cable strap
10		Standardizing unit complete (specify model & serial no. of instrument).
11	93026	Post
12	A2064	Cover
13	34976	6-40 x 9/16" Fillister-head screw
14	93657	Post
15	93658	Index
16	68345	6-40 x 3/16" Special-head screw
17	A2065	Cover
18	40066	8-32 x 1/4" Fillister-head screw
19	65984	10-32 x 1 1/2" Fillister-head screw
20	93034	Shaft
21	89117	Shaft retaining ring
22	24804	Thrust washer
23	A2063	Slidewire back cover

*Not Shown

(continued on page 19)

ITEM	PART NO.	DESCRIPTION
24	89865	Slidewire cover
25	89112	Post for slidewire cover
26	28211	Washer
27	92390	Pulley for instruments with 3-, 4.5-, 7- and 24-second pen travel
	A3811	Pulley for instruments with 0.4- and 1-second pen travel
28	85291	Pully shaft
29	80607	Retaining ring
30	82403	6-40 x 1/8" Bristo flat-point setscrew
31	67029	10-32 x 5/16" Fillister-head screw
32	10075	Washer
33	85272	Gear stop for instruments with 3-, 4.5-, 7- and 24-second pen travel
	93320	Gear stop for instruments with 0.4 and 1-second pen travel
34	31427	6-40 x 5/16" Fillister-head screw
35	20021	6-40 x 1/4" Flat-head screw
36	76276	Tension-shaft clamp
37	76273	Tension shaft
38	85319	Cord clamp
39		Balancing motor
	96871	0.4-second pen speed motor (120 volt, 50-60 cycle)
	96873	1-second pen speed motor and gear train complete
	96871	1000 rpm motor (120 volt, 50-60 cycle)
	97640	Pinion (26T-64P) order with 6-40 x 1/8"flat-point setscrew No. 82403
	97638	Gear complete (72T-64P)
	96848	3-second pen speed motor and gear train complete
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96868	Gear complete (88T-64P)
	96849	4.5-second pen speed motor with pinion (120 volt, 60 cycle)
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96859	Gear complete (140T-64P)
	93699	7-second pen speed motor (120 volt, 60 cycle)
	96874	24-second pen speed motor and gear train complete
	96872	1000 rpm motor (120 volt, 60 cycle)
	97652	Gear complete (88T-64P, 15T-48P)
	97647	Gear complete (120T-48P)
40	86043	Needle bearing
41	A2102	Bull gear complete for 3-, 4.5-, 7- and 24-second pen travel (includes setscrew and items 5, 8, 34 thru 38 and 42)
	86052	Bull gear and hub only for 3-, 4.5-, 7- and 24-second pen travel
	B1556	Bull gear complete for 1- and 0.4-second pen travel (includes setscrew and items 5, 8, 34 thru 38 and 42)
	93360	Bull gear and hub only for 1- and 0.4-second pen travel
	89049	5/16-18 x 5/16" flat point setscrew
42	A2104	Sheave
		NOT SHOWN
		Power transformer for 2-pen ac-dc instrument mounted on front of hinged panel
	84245	Transformer (50-60 cycle, 120 volt prim., 8 volt sec.)
	72557	Transformer (25 cycle, 120 volt prim., 9 volt sec.)
	93672	Shield
	39770	6-40 x 1/4" Fillister-head screw

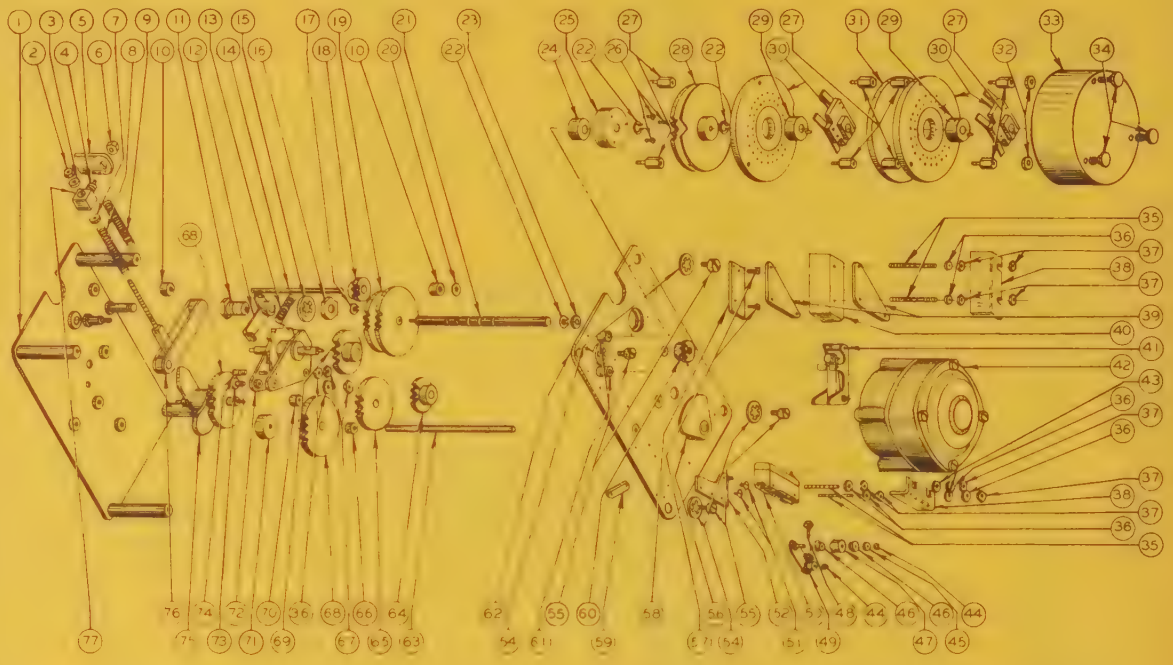

FIGURE 19. MULTIPLE-SWITCHING ASSEMBLY FOR MULTIPLE-POINT RECORDER

ITEM	PART NO.	DESCRIPTION
	98068	Dynamaster multiple switching mechanism complete for all instruments except those with battery standardizing, less motor and switch deck. Specify model and serial number of instrument.
	98069	Dynamaster multiple switching mechanism complete for all instruments with battery standardizing, less motor and switching deck. Specify model and serial number of instrument.
1	98021	Front plate complete
2	82647	6-40 Self-locking nut
3	88083	Yoke washer
4	88081	Depressor yoke
5	86088	Depressor bar
6	89653	Depressor-yoke nut
7	88082	Spring collar
8	88080	Printing pressure spring
9	70610	Printing-lever spring
10	53889	Collar, including setscrew
	82403	6-40 x 1/8" Bristo flat-point setscrew for item 10
11	95557	Latch-lever adjustment nut (see item 12)
12	95556	Latch-lever complete, includes items 11, 15, and 16
13	88032	Latch-lever spring
14	88092	Miter-gear shaft
15	40262	Lockwasher
16	40278	5/16"-32 x 1/8" Hexagon nut
17	79854	Tru-Arc retaining ring
18	88056	Pinion complete including setscrew
	82403	6-40 x 1/8" Bristo flat-point setscrew for item 18
19		Gear including setscrew
	A5395	(50T x 84T - 48P) for 2-, 3-, or 6-point instrument
	A5396	(60T x 84T - 48P) for 4- or 8-point instrument
	A5397	(70T x 84T - 48P) for 10-point instrument
	A5398	(75T x 84T - 48P) for 12-point instrument
	A5399	(72T - 40P x 84T - 48P) for 16-point instrument
	A5400	(95T x 84T - 48P) for 20-point instrument
	A5401	(100T x 84T - 48P) for 24-point instrument
	82413	10-32 x 3/16" Bristo flat-point setscrew for item 19
20	86048	Thrust washer
21	88084	Multiple-switching shaft for 560 Dynamaster
	96842	Multiple-switching shaft for 570 Dynamaster
22	91015	Retaining ring
23	61381	Thrust washer
24	88085	Ball bearing
25	88086	Bearing housing

ITEM	PART NO.	DESCRIPTION
26	89037	4-48 x 3/8" Flat-head screw
27	88068	Post 7/16" long, not including threaded end
	89375	Post 9/16" long, not including threaded end
	88070	Post 5/8" long, not including threaded end
	88144	Post 1 5/32" long, not including threaded end
28	89000	Gear (120T-48P) and cam assembly
29	96132	Switch-blade collar
30	98011	Switch plate and contact arm for 2-3-4-6-8-12-24 point multiple
	98013	Contact arm only for above
	98014	Switch plate and contact arm for 10 & 20 pt. multiple
	98016	Contact arm only for 10 & 20 pt. multiple
	98017	Switch plate and contact arm for 16 pt. multiple
	98019	Contact arm only for 16 pt. multiple
31	88067	Separating plate
32	82381	Washer
33	88071	Switch cover for a-c Bridge type instruments
	88145	Switch cover for d-c Potentiometer type instruments
34	55785	10-32 x 3/8" Thumb screw
35	86086	Switch stud
36	79008	#6 Lockwasher
37	20903	#6-40 Hex. nut
38	89863	Switch cover
39	79634	Cam-follower plate
40	54866	Snap-action switch
41	79622	Cam follower complete
	*79621	Spacer }
	*88173	Cam-follower shaft } used with item 41
	*80607	Retaining ring }
42	88060	Motor, 120 volt, 50-60 cycle for 8-, 15-, or 30-second print interval
	76209	Motor, 120 volt, 25 cycle for 8-, 15-, 30- or 60-second print interval
	92128	Motor, 120 volt, 50-60 cycle for 1.0-, 1.9-, 2.3-, 3.9- or 4.5-second print interval
	55327	Motor, 120 volt, 50-60 cycle for 60-second print interval
43	21252	Washer
44	80607	Retaining ring (see item 49)
45	15536	Washer (see item 49)
46	70903	Oil-less bushing (see item 49)
47	98044	Cam roller (see item 49)
	98043	Cam roller complete, includes items 46 and 47
48	79626	6-32 x 7/16" Hex-head screw (see item 49)
49	98040	Cam-follower arm complete, includes items 44, 45, 46, 47 and 48 (see item 52)
50	98035	Snap-acting switch
51	20335	6-40 x 5/16" Flat-head screw
52	98036	Cam follower complete (includes item 49)
54	35638	#10 Lockwasher
55	66537	10-32 x 1/4" Fillister-head screw
56	98070	Cam complete
57	21407	6-40 x 1/2" Flat-head screw
58	94890	Switch mounting plate
59	98053	Mounting strap
60	86018	Pinion (30T-48P) not including setscrew
	*82403	6-40 x 1/8" Bristo flat-point setscrew for item 60
61	95911	Spacer
62	88001	Back plate complete
63	98072	Cam shaft
64		Motor pinion
	92129	(46T-48P) for 8-second print interval
	94261	(22T-48P) for 3.9- or 60-second print interval
	88061	(19T-48P) for 4.6- or 30-second print interval
	89150	(36T-48P) for 2.3- or 15-second print interval
	94460	(37T-48P) for 1.9-second print interval
	98000	(63T-48P) for 1.0-second print interval
	82413	10-32 x 3/16" Bristo flat-point setscrew for item 64
65		Gear, including setscrew
	94263	(86T-48P) for 3.9- or 60 second print interval
	88014	(89T-48P) for 2.3- or 4.6-second print interval
	92131	(62T-48P) for 8-second print interval
	94462	(71T-48P) for 1.9-second print interval
	94464	(62T-48P) for 1.0-second print interval
	82413	10-32 x 3/16" Bristo flat-point setscrew for item 65
66	53172	Collar, not including setscrew
	*82403	6-40 x 1/8" Bristo flat-point setscrew
67	772	6-40 Hex. nut
68	94515	Gear complete (74T-48P)

*Not Shown

(continued on page 22)

(continued from page 21)

ITEM	PART NO.	DESCRIPTION
69		Ratchet-shaft gear
	88037	(100T-48P) for 2-, 3- or 6-point instrument
	88072	(90T-48P) for 4- or 8-point instrument
	94427	(84T-48P) for 10-point instrument
	86076	(75T-48P) for 12-point instrument
	89874	(54T-40P) for 16-point instrument
	94435	(57T-48P) for 20-point instrument
	96116	(50T-48P) for 24-point instrument
	82413	10-32 x 3/16" Bristo flat-point setscrew for item 69
70	88034	Cam roll
71	98031	Ball bearing
72	88019	Ratchet complete, includes items 36, 67, 70, 71, 73 and 74
73	98032	Shoulder screw
74	98033	Stud
75	98073	Cam shaft assembly complete
76	88042	Printing lever complete
77	95913	Sleeve

PRINT INTERVAL	MOTOR (ITEM 42 FIG. 19)		GEAR			
	50-60 CYCLE	25 CYCLE	ITEM NUMBER	PITCH	NUMBER OF TEETH	PART NUMBER
1.0 sec.	92128	.....	64 65	48 48	63 62	98000 94464
1.9 sec.	92128	.....	64 65	48 48	31 71	94460 94462
2.3 sec.	92128	.....	64 65	48 48	36 89	89150 88014
3.9 sec.	92128	.....	64 65	48 48	22 86	94261 94263
4.5 sec.	92128	.....	64 65	48 48	19 89	88061 88014
8 sec.	88060	76209	64 65	48 48	46 62	92129 92131
15 sec.	88060	76209	64 65	48 48	36 89	89150 88014
30 sec.	88060	76209	64 65	48 48	19 89	88061 88014
60 sec.	96738	76209	64 65	48 48	22 86	94261 94263

FIGURE 20. TABLE OF MOTORS AND CHANGE GEARS FOR MULTIPLE-SWITCHING ASSEMBLY

LOW-SPEED GEAR TRAIN				HIGH-SPEED GEAR TRAIN			Gear Position	Pitch	Number of Teeth	Part Number	Identification
2 rpm Telechron Motor	4 rpm Telechron Motor	10 rpm Holtzer-Cabot Motor	60 rpm Holtzer-Cabot Motor	4 rpm Holtzer-Cabot Motor	10 rpm Holtzer-Cabot Motor	60 rpm Holtzer-Cabot Motor					
Chart Speed (inches/hour)			← Chart Speed (inches/min.) →			Chart Speed (inches/sec.)					
3/4	1 1/2	3 3/4	3/8	1	2 1/2	1/4	1 2	40 40	16 64	92105 92103	C H
1	2	5	1/2	1 1/3	3 1/3	1/3	1 2	48 48	24 72	79225 79223	J N
1 1/2	3	7 1/2	3/4	2	5	1/2	1 2	48 48	32 64	79218 79222	K M
2	4	10	1	2 2/3	6 2/3	2/3	1 2	40 40	32 48	79227 79221	E F
3	6	15	1 1/2	4	10	1	1 2	48 48	48 48	79224 79224	L L
4 1/2	9	22 1/2	2 1/4	6	15	1 1/2	1 2	40 40	48 32	79221 79227	F E
5	10	25	2 1/2	6 2/3	16 2/3	1 2/3	1 2	48 48	50 30	94210 94212	G D
6	12	30	3	8	20	2	1 2	48 48	64 32	79222 79218	M K
9	18	45	4 1/2	12	30	3*	1 2	48 48	72 24	79223 79225	N J
10	20	50	5	13 1/3	33 1/3	3 1/3*	1 2	32 32	50 15	94214 94216	B A
12	24	60	6	16	40	4*	1 2	40 40	64 16	92103 92105	H C

*60 cycle only

FIGURE 21. TABLE OF MOTORS AND CHANGE GEARS FOR SINGLE-SPEED CHART DRIVE

FAST SPEED GEAR TRAIN					CHANGE GEARS	
MOTOR SPEEDS					NUMBER OF TEETH	PART NUMBER
1 RPM	2 RPM	4 RPM	10 RPM	60 RPM		
B1277	B1276	96738	88060	B1279 53680(a)		
CHART SPEED (inches per minute)				CHART SPEED (inches per second)		
1/4	1/2	1	2-1/2	1/4 (a)	16 64	A2531 A2529
1/3	2/3	1-1/3	3-1/3	1/3 (a)	24 72	A1539 A1536
1/2	1	2	5	1/2 (a)	32 64	A1540 A1544
2/3	1-1/3	2-2/3	6-2/3	2/3 (a)	32 48	A2527 A2526
1	2	4	10	1 (a)	48 48	A1542 A1542
1-1/2	3	6	15	1-1/2 (b)	48 32	A2526 A2527
2	4	8	20	2 (b)	64 32	A1544 A1540
3	6	12	30	3 (b)	72 24	A1536 A1539
4	8	16	40	4 (b)	64 16	A2529 A2531

(a) Used for two-pen Dynamasters, and with only the five speeds indicated.
(b) May run 1% slow.

FIGURE 22. CHART SPEEDS & CHANGE GEARS FOR WIDE-STRIP DYNAMASTERS WITH 2-SPEED ATTACHMENT T84. MOTORS ARE HOLTZER-CABOT 120V 60 CYCLE.

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

NOT SHOWN ITEMS

PART NO.	DESCRIPTION
	AUTOMATIC STANDARDIZATION TIMER:
91945	Timer, including motor, bracket, switch etc. (120 volt, 50-60 cycle)
95693	Timer, including motor, bracket, switch etc. (120 volt, 25 cycle)
18339	6-40 x 3/16" Fillister-head screw for mounting timer
89127	Switch for timer
	CONSTANT VOLTAGE UNIT
91936	Constant voltage unit complete (No Batt ®) 60 cycle
91937	Chassis
91938	Power transformer
91941	Relay
96177	Resistance spool (1000 ohms manganin)
96176	Resistance spool (800 ohms nickel ±5%)
91942	Rectifier
91943	Capacitor (100 mfd, 12 volts d-c)
96178	Resistance spool (2500 ohms manganin)
96175	Isolation transformer
96171	Capacitor (0.22 mfd, 850 volts a-c)
96172	Capacitor (0.235 mfd, 850 volts a-c) — as required
96173	Capacitor (0.25 mfd, 850 volts a-c)
96174	Capacitor (0.295 mfd, 850 volts a-c)
C1669	Constant voltage unit complete (50 cycle)
	POWER PACK
92976	Power pack for d-c resistance recorder
92975	Chassis
76324	Transformer
91942	Rectifier
92977	Condenser
79357	Choke
93305	Resistor
90636	Cover
	AUTOMATIC PEN LIFTER (Attachment T6)
93336	Rotary solenoid
82096	Spring
93347	Rectifier
	PEN ACCESSORIES
A6500	2-ounce bottle of red ink
A6502	2-ounce bottle of blue ink
A6526	2-ounce bottle of black ink (reproducible)
72693	Pen filler
A3801	Pen starter
32900	Pen cleaner
	MISCELLANEOUS PARTS
98130	1/4-ounce bottle of Cramolin
A5700	1-pint Bristol cleaning fluid (metal container)
91982	2-ounce can Houghton Gearlub
89030	Drive cord

EXTRA PARTS FOR 25 CYCLE INSTRUMENTS

	CAPACITOR (mounting of right under amplifier shelf)
74480	Capacitor (0.5 mfd, 600 volts d-c)
82656	6-32 x 3/16" Binding-head screw
	OUTPUT TRANSFORMER (on back of case)
92736	Output transformer
64029	8-32 x 7/16" Fillister-head screw
72166	Spacer for screw, part #64029
	RESISTOR (mounted on back of panel of d-c instrument)
93961	Resistor (150 ohm, 25 watt)
45078	Washer (brass)
35218	Washer (insulating)
65876	6-40 x 2 1/4" Fillister-head screw

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PARTS LIST
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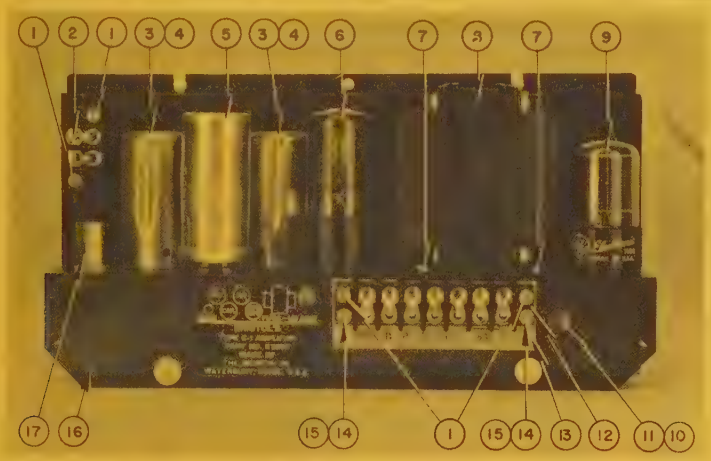
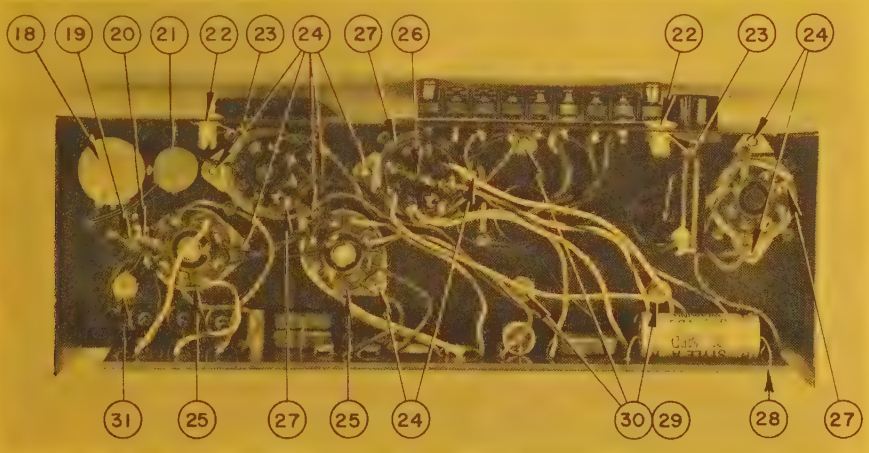
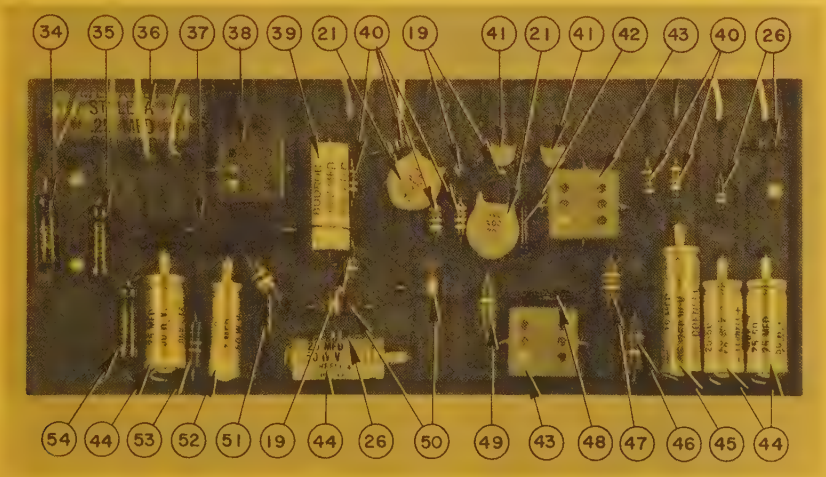
BRISTOL'S® AMPLIFIERS
SERIES C-1, C-3, C-4, D, D-2 & D-3
USED IN SERIES 560, 565 & 570 DYNAMASTERS







BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
	97600	Series C-1 Amplifier complete
	C1096	Series D Amplifier complete
1	86100	6-32 x 1/2" Self tapping screw
2	83987	Terminal Block (2-point)
3	91040	Tube shield
4	90596	7F7 Tube
5	83974	Capacitor
6	83972	6V6 - GT Tube for series C-1 amplifier
	A2236	5881 Tube for series D amplifier
7	40066	8-32 x 1/4" Fillister-head screw
8	90582	Transformer for series C-1 amplifier
	B1215	Transformer for series D amplifier
NOT SHOWN	A2240	Transformer mounting plate for series D amplifier
	A2238	8-32 x 5/8" Flat-head screw for above plate
	A2239	Spacer for above plate
9	90595	6X5 - GT Tube (for series C-1 amplifier)
	A4409	6AX5 - GT Tube (for series D amplifier)
10	84716	Fuse holder
11	64283	Fuse (1/8 amp Littlefuse)
12	90594	Terminal block (7-point)
NOT SHOWN	90636	Shield over 7-point terminal block
13	91946	Marking strip (7-point)
14	91136	6-32 x 3/4" Binding-head screw
15	45081	Collar
16	C1083	Chassis complete for series C-1 amplifier
	C1097	Chassis complete for series D amplifier
17	84549	Potentiometer shaft cap
18	97601	Potentiometer (C-taper) (1 megohm ±20% tolerance)
19	83980	Resistor (1 megohm, 1/2 watt, ±10% tolerance)
20	83981	Resistor (4.7 megohm, 1/2 watt, ±10% tolerance)
21	A2182	Capacitor (ceramic) (.075 microfarad, 400 volt, ±5% tolerance)
22	89121	Dzus fastener
23	89122	Washer
24	92359	Eyelet for mounting tube sockets
25	90593	Loctal socket
26	72226	Resistor (10,000 ohm, 1/2 watt ±10% tolerance)
27	71708	Octal socket
28	97632	Printed circuit assembly complete for series C-1 amplifier (includes items 19, 21 and 34 thru 54)
	B1214	Printed circuit assembly complete for series D amplifier includes items 19, 21, 34 thru 50 and 52 thru 54.
	97602	
29	35639	Lockwasher
30	26966	8-32 Hex nut
31	97630	Capacitor (ceramic) (470 micro microfarads ±10% tolerance)
34	97617	Resistor (250 ohm, 5 watt ±5% tolerance)
35	97619	Resistor (10,000 ohm, 5 watt ±5% tolerance)
36	97627	Capacitor (paper) (.25 microfarad, 600 volt, ±20% tolerance)
37	97620	Resistor (22,000 ohm, 10 watt ±5% tolerance)
38	97628	Capacitor (mica) (.003 microfarad, 500 volt, ±2% tolerance) for C-1 only.
39	97626	Capacitor (paper) (.022 microfarad, 600 volts ±10% tolerance)
40	83979	Resistor (470,000 ohm, 1/2 watt ±10% tolerance)
41	97629	Capacitor (ceramic) (250 micro microfarad, 1,000 volt, ±10% tolerance)
42	97684	Resistor (240,000 ohm, 1/2 watt ±1% tolerance)
43	90592	Capacitor (mica) (.0062 microfarad, 500 volt, ±5% tolerance)
44	97625	Capacitor (electrolytic) (25 microfarad, 50 volt -10% +150% tolerance)
45	97624	Capacitor (electrolytic) (12 microfarad, 250 volt -10% +150% tolerance)
46		Calibrating Resistor
47	97683	Resistor (75,000 ohm, 1/2 watt ±1% tolerance) for C-1 amplifier
	89085	Resistor (68,000 ohm, 1 watt ±10% tolerance) for D amplifier
48	97685	Resistor (300,000 ohm, 1/2 watt ±1% tolerance)
49		Calibrating resistor (as required when parallel "T" is tuned)
50	87018	Resistor (100,000 ohm, 1 watt ±10% tolerance)
51	97622	Resistor (680,000 ohms, 1 watt ±5% tolerance) for C-1 amplifier only
52	97623	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for C-1
	97625	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for D
53	97621	Resistor (10,000 ohm, 1 watt, ±5% tolerance)
54	97618	Resistor (1,000 ohm, 5 watt, ±5% tolerance) for series C-1
	97617	Resistor (250 ohm, 5 watt, ±5% tolerance) for series D
		NOT SHOWN
	77982	6-32 x 3/16" Binding-head screw for mounting printed circuit board to chassis

PART NO.	DESCRIPTION
C1551	Series C-3 Amplifier complete
	Same as C-1 amplifier except for the following additions.
83980	Resistor 1.0 megohm 1/2 watt
A3636	Socket
94585	Decalcomania
C1646	Series C-4 Amplifier (50 cycle) complete
	Same as C-1 amplifier except for the following changes.
	Item 43 is changed to 93960
93960	.0075 microfarad capacitor
	Add to basic C-1 amplifier
A2812	Resistor 390,000 ohm
94585	Nameplate
C1552	Series D-2 Amplifier complete
	Same as D amplifier except for the following additions.
83980	Resistor 1.0 megohm 1/2 watt
A3636	Socket
94585	Decalcomania
C1650	Series D-3 Amplifier complete
	Same as D amplifier except for the following changes.
	Item 43 is changed to 93960
93960	.0075 microfarad capacitor
	Item 21 is changed to A2182
A2182	.075 microfarad capacitor
	Add to basic D amplifier
94585	Nameplate

INSTRUCTION NO. Y19822
(Issue of 3/59)

MOUNTING PROCEDURE FOR SERIES 590

RACK-MOUNTED DYNAMASTER

Herewith: Mounting dimension drawing 010831

Mounting Procedure

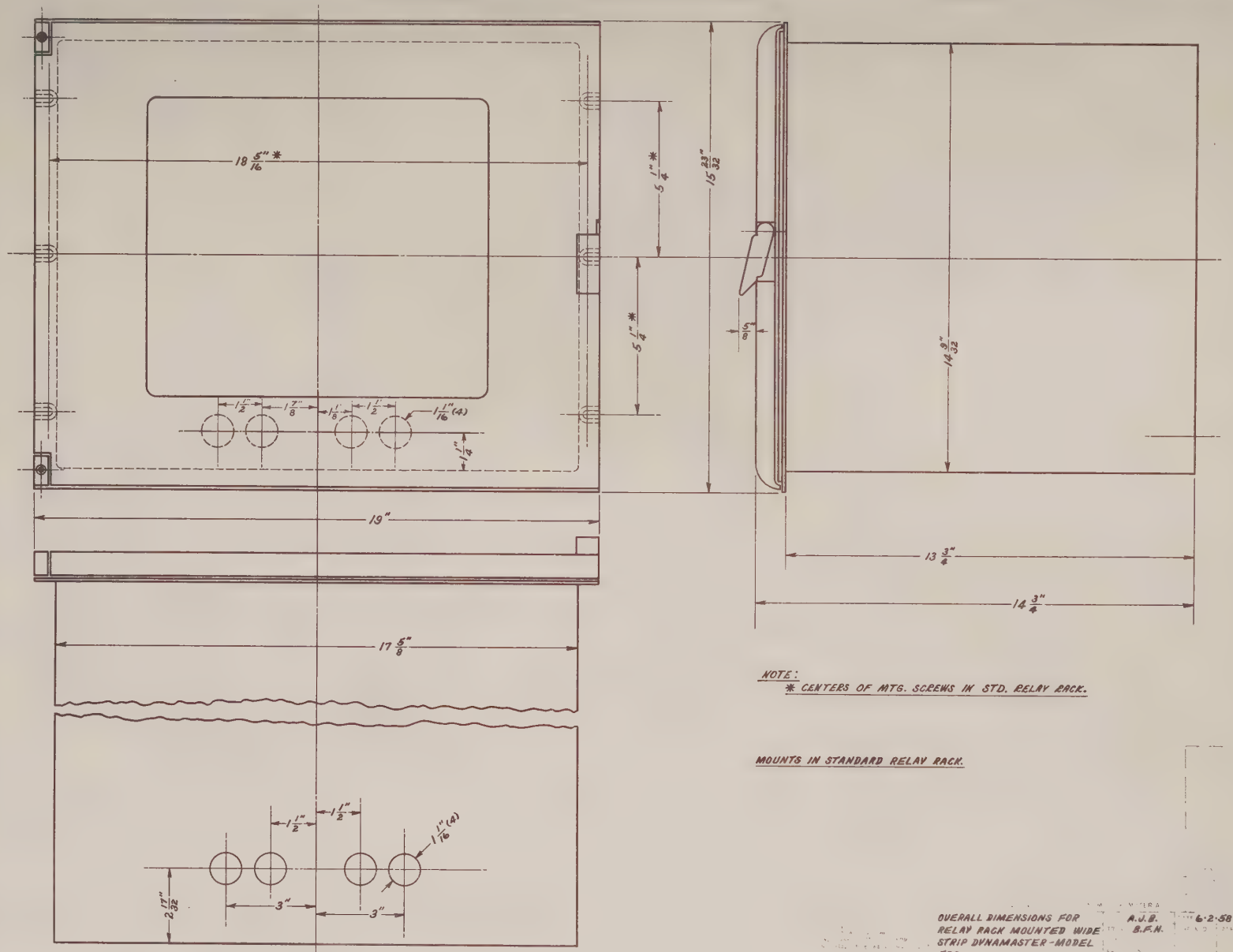
To mount a rack-mounted Dynamaster, the door must first be removed by unfastening the door stop and removing the upper hinge.

The instrument may then be mounted into the rack and fastened with screws furnished with the accessories. After the mounting screws are securely tightened, the door may be replaced and the door stop refastened.

The instrument is provided with four holes in the back of the case and four holes in the bottom of the case to accommodate standard conduit fittings.

THE BRISTOL COMPANY
WATERBURY 20, CONNECTICUT, U.S.A.

010831 DR. 221



NOTE:
* CENTERS OF MTG. SCREWS IN STD. RELAY RACK.

MOUNTS IN STANDARD RELAY RACK.

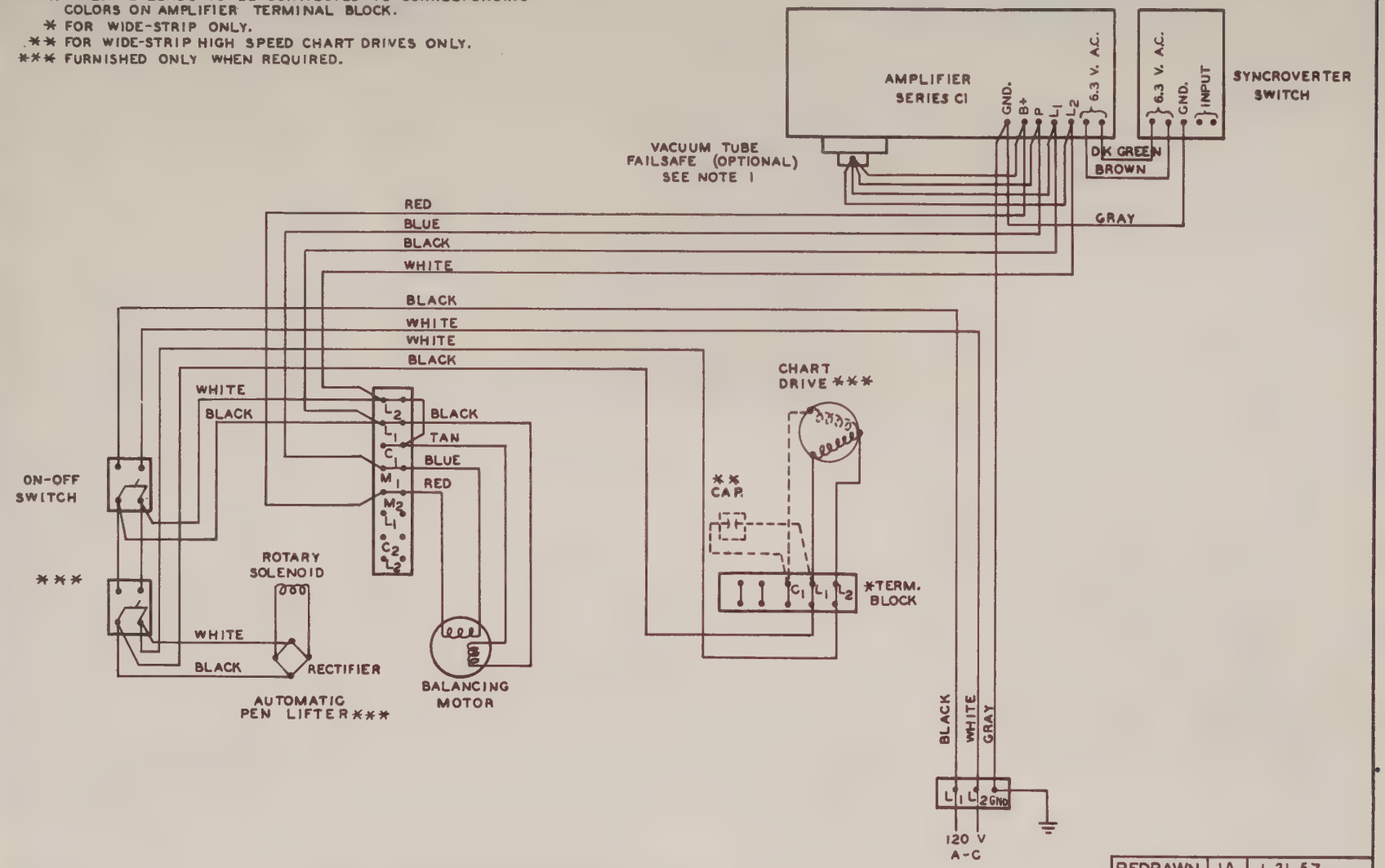
OVERALL DIMENSIONS FOR RELAY RACK MOUNTED WIDE STRIP DYNAMASTER - MODEL 590.

A.J.B. 6-2-58
B.F.H.

1" = 1/2"

NO. 010831 DR 221
DIR-600

NOTES:
1. FAILSAFE LEADS TO BE CONNECTED TO CORRESPONDING COLORS ON AMPLIFIER TERMINAL BLOCK.
* FOR WIDE-STRIP ONLY.
** FOR WIDE-STRIP HIGH SPEED CHART DRIVES ONLY.
*** FURNISHED ONLY WHEN REQUIRED.



POWER CIRCUIT WIRING DIAGRAM

FOR SINGLE-POINT, WIDE-STRIP OR ROUND-CHART D-C DYNAMASTER, FOR USE WITH SERIES CI AMPLIFIER

REDRAWN	JA	1-21-57

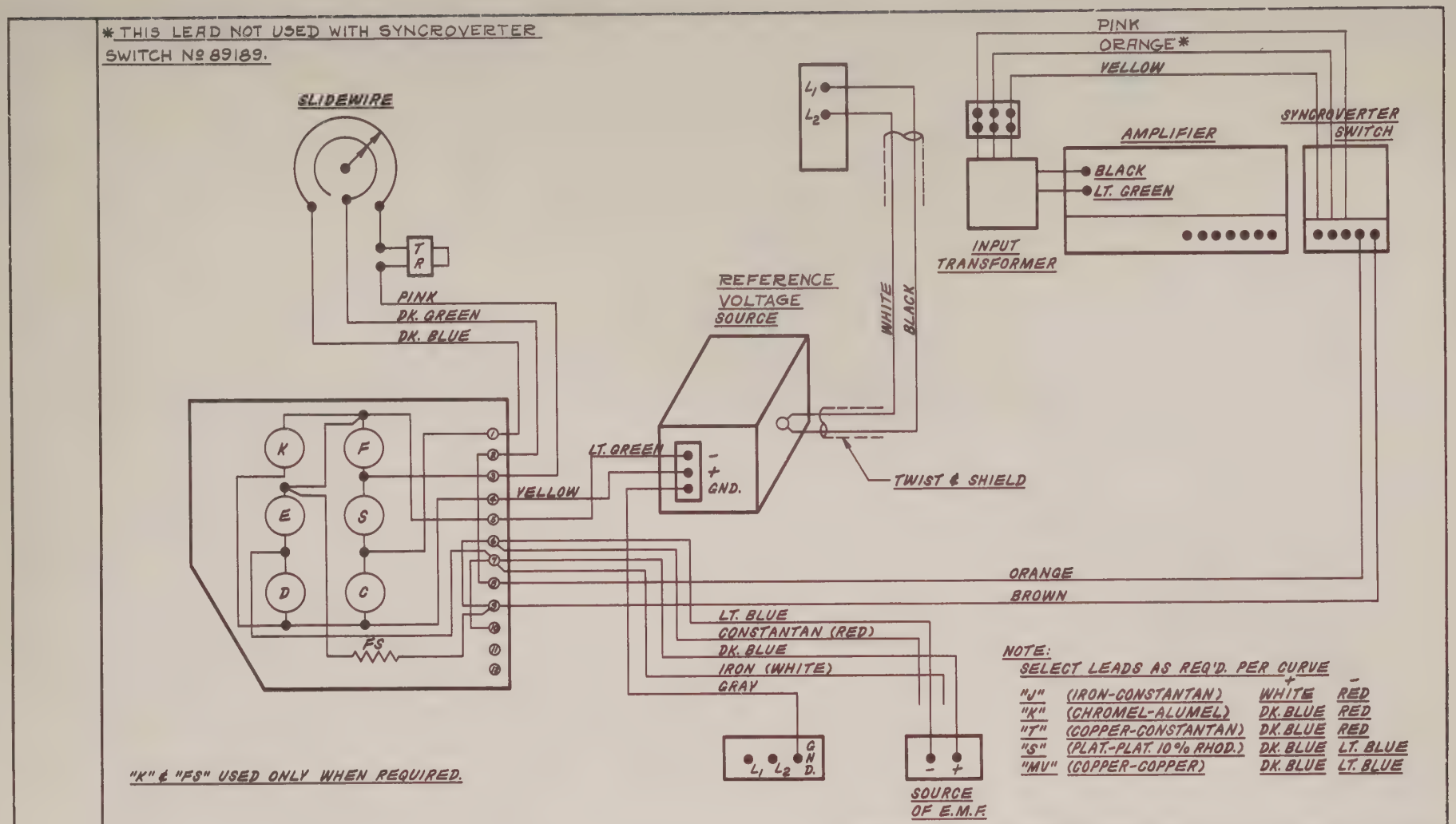
THE BRISTOL COMPANY
WATERBURY CONN U S A.

DRAWN LL TRACED
DATE 9-1-54 DRAWER NO. 122
SHEET NO. 012683-CI

B. CO. ORDER NO. CUSTOMER ORDER NO. SERIAL NO.

	11-9-56	11-2-55	12-20-54	REVISION DATES
6-16-58	12-12-55	11-13-55	11-9-54	

DEFIANCE NO. 9x 52 4



MEASURING CIRCUIT WIRING DIAGRAM FOR SINGLE POINT MILLIVOLTMETER WITH VOLTAGE REFERENCE SOURCE.

DRAWN B.F.H. | DATE 2-2-60 | TRACED B.F.H. | CHECKED | APPROVED

6-1-61

THE BRISTOL COMPANY
WATERBURY CONN. U.S.A.

SIZE | DWG. NO. 122
NO 018216

Instruction W-18220
Issued April 1954

HOW TO ORDER PARTS AND SUPPLIES

FOR BRISTOL PRODUCTS

In all correspondence concerning any product of the Bristol Company, always give the model and serial number of the product concerned. Send your purchase order or quotation request to the nearest Bristol Company Branch Office (see the back of this sheet for addresses).

REPLACEMENT PARTS

When ordering replacement parts look up the part name and number in the parts list provided with the instructions that came with your product. When you cannot find a part number, give an accurate description of the part. If you have mislaid your parts list write for a new one giving the model and serial number of the product.

CHARTS

In ordering charts for recorders, give the chart number (printed on the chart and also on the instrument name plate).

Avoid inconvenient emergency orders by keeping a six months supply of charts on hand for each of your recorders.

THERMOCOUPLES

Pyrometer thermocouples should be ordered from Bulletin P-1238. Be sure to specify the catalog number and the length. If you do not have Bulletin P-1238, write for one.

Pyrometer users should always have a supply of spare thermocouples.

SAMPLE PURCHASE ORDER:

QUANTITY REQUIRED	DESCRIPTION	PART, CHART OR CATALOG NUMBER
1000	Charts, 0° to 1500°F	5342
5	7-day electric chart drive for 115 volts, 60 cycles	86226
4	Pen arms marked CD	49703
1	Knurled plastic knob on outside of case, ½" diameter, 3/16" hole for moving set-point index	none given
1	1 oz. bottle red ink	6883
	The above parts are for a Bristol thermometer controller Model 1T1X500B-2, serial number 767211.	
4	IC thermocouples, length 30"	3BS14N2
	The above thermocouples are for a Bristol pyrometer Model 487-L, serial number 202953	

THE BRISTOL COMPANY · Waterbury 20, Conn.

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